La Semilla

2006 Technical Report

Tucson Plant Materials Center

USDA
Natural Resources Conservation Service

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Introduction

The Tucson Plant Materials Center (TPMC) is operated by the USDA-Natural Resources Conservation Service. In 1935 the USDA-Natural Resources Conservation Service recognized the need for adapted plant material for use in their conservation programs. This need was addressed by the establishment of plant materials nurseries in critical areas throughout the United States. The Plant Materials program has grown into a network of 27 centers throughout the United States. The Tucson Plant Materials Center (Tucson PMC) was one of the initial centers established to provide adapted plant material for conservation programs in the southwest United States. Over the past 70 years the Tucson PMC has developed and evaluated plant materials and technologies for their establishment that have enhanced conservation efforts throughout its service area.

The Tucson PMC service area supports the Sonoran, Mohave and Chihuahuan desert regions. Plant Material products and support is provided to areas within the states of Arizona, California, Nevada, Utah, and New Mexico. The Tucson PMC works closely with its customers to provide effective, cost-efficient vegetative solutions for conservation problems. Rangelands, mined lands, critical areas, urban and urban interface areas, riparian areas, croplands, water and air quality, invasive species, and wildlife habitat all present resource issues within the PMC service area.

The PMC evaluates the conservation potential of native grasses, shrubs, Forbs and trees at the federally owned 45-acre farm in Tucson, Arizona. Selected plant materials become part of advanced trials designed to develop cultural and management practices that enhance seed production and ease of establishment in their native plant communities or environments. These practices, along with efficiency and adaptability, are assessed using field plantings at selected test sites throughout the PMC service area.

The Tucson PMC works in partnership with NRCS field offices, resource conservation and development (RC&D) groups, conservation districts, federal and state agencies, non-profit groups and private landowners to develop improved resource technology. Cooperation with agencies and groups other than NRCS provides opportunities for the joint development of plant materials and management practices as well as for exchange of information, seed, and planting stock.

This publication provides information on studies and activities carried out at the PMC during 2006.

Summary of 2006 Weather Conditions at the Tucson Plant Materials Center Tucson, Arizona

Month	Temperature (°F)		Precipitation (inches)
	Maximum	Minimum	
January	83	32	0
February	87	35	0
March	86	33	0.83
April	96	44	0
May	104	64	0
June	110	70	0.47
July	114	70	3.93
August	105	72	1.21
September	103	63	1.70
October	100	44	0.57
November	88	28	0.07
December	80	26	0.71
	Avg. 87.3	Avg. 57.7	Total 9.49

Frost Free Days = 353

Days Above 100 °F = 93

Coldest Temperature = December 1st 26 °F

Hottest Temperature = July 21st 114 °F

1st day 100 °F = May 11th

1st day 32 °F = January 17th

Pima Pappusgrass Population Development Results in Release of Pima Germplasm

STUDY NUMBER: AZPMC-P-9901-CR

Description:

Pima pappusgrass (*Pappophorum vaginatum* Buckley) is also known as Whiplash pappusgrass. The goal of the population development of this species is to provide a genetically broad-based population with a wide area of adaptation. Plant materials resulting from this project will be valuable in the revegetation of the diverse environments of southern Arizona. Pima pappusgrass is not available through any commercial sources, so all genetic resources are from field collections Pima germplasm Pima (or Whiplash) pappusgrass was released in 2006 from the Tucson PMC. Sixteen accessions were evaluated at the PMC for this release.

Materials and Methods:

Seed were collected from at least 50 individuals from 18 sites in southern Arizona (Table 1). Sixteen accessions were planted into a randomized complete design at the Tucson PMC in 1999. Rows were spaced 42 inches apart. An experimental unit consisted of 10 plants.

Table 1: Collection locations of Pima pappusgrass (*Pappophorum vaginatum*) accessions.

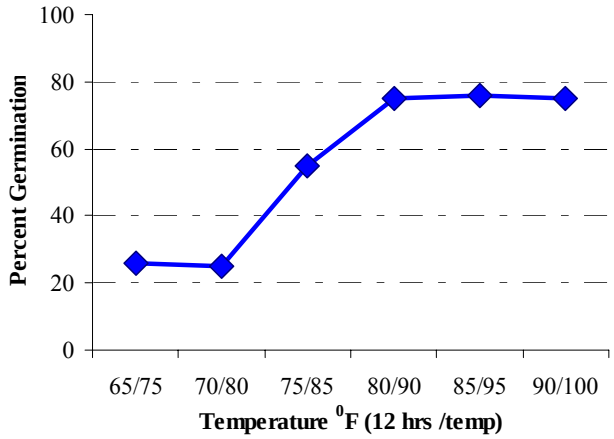
Accession Number	Collection Date	Collection Location	Comments
9064074	8/11/96	T24S, R28E, Sec. 12	Douglas, AZ
9064075	11/19/96	T19S, R19E, SE1/4 of SE1/4 of Sec. 24	Hwy 90 on Sands Ranch
9064076	9/25/96	T21S, R24E, SW1/2 of SE1/4 of Sec. 27	47 Ranch
9064077	9/26/96	T23S, R24E, SE1/2 of NW1/4 of Sec. 10	Lee Station Ranch
9064078	9/19/96	T17S, R20E, NE1/4 of NE1/4 of Sec. 7	
9064079	10/19/96	T13S, R20E, NE1/4 of NW1/4 of Sec. 26	Harris' VF Ranch
9064080	9/10/96	T8S, R2E, SE1/4 of Sec. 20	
9064081	9/5/96	Tohono O'odham Res.	near roadside
9064082	9/5/96	Tohono O'odham Res.	
9064083	12/3/96	16S, R10E, NW1/4 of Sec. 7	Three Points, AZ
9064106	10/3/97	T21S, R9E, NW1/4 of SW1/4 of Sec. 34	Chilton's Arivaca Ranch
9064124	8/6/99	T17S, R14E, NW1/4 of SE1/4 of Sec. 20	pasture 5N in SRER
9064125	8/13/99	T17S, R20E, NW 1/4 of Sec. 4	Benson, AZ
9064126	8/16/99	T24S, R28E, SE1/4 of NE1/4 of Sec. 17	Douglas, AZ
9064127	10/4/99	T20S, R20E, NW 1/4 of Sec. 6	2 mi. N of Mustang Corners
9064128	8/12/99	1920 W. Copper St., Tucson, AZ	undeveloped lot
9067450	unknown	unknown	unknown

Introduction

Pima pappusgrass is a native perennial warm season bunchgrass. It is found along roadsides, in valleys and in low places on plains. Pima pappusgrass occurs in the southwestern United States, Mexico, Argentina and Uruguay. In Arizona, Pima pappusgrass is found primarily in Pima and Cochise counties at elevations ranging from 2,500 to 4,000 feet. Pima pappusgrass has erect culms, 25 to 40 inches (60-100 cm) tall. The leaf blades are 0.08 to 0.20 inches (2-5 mm) wide and flat with edges that may roll inward. The panicle is a spikelike 4 to 8 inches (10-20 cm) long, tawny to whitish colored with a tapered end. Spikelets are short-pediceled with 1 or 2 fertile florets and 2 or 3 sterile reduced ones.

Results and Discussion

Eleven accessions of Pima pappusgrass were evaluated for germination across a range of temperatures. The optimum temperature range for germination in this study was 85 to 100 degrees. This temperature correlates with summer temperatures in southern Arizona during the monsoon rains. This would be the optimum time for germination.



Optimum temperature range for germination of Pima pappusgrass.

The 18 accessions in the evaluation planting did not express any discernable phenotypic differences. Seed harvested from the planting was harvested in bulk and used to establish a G0 increase block in 2005. This block will provide seed for a selected release of Pima pappusgrass.

Reference

1. Flora of North America Editorial Committee, eds. 2003. Flora of North America North of Mexico. Vol 25. New York and Oxford.
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UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
TUCSON PLANT MATERIALS CENTER
TUCSON, ARIZONA

NOTICE OF RELEASE OF A SELECTION OF WHIPLASH PAPPUSGRASS SELECTED CLASS OF GERMPLASM

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), announce the release of a selected class of whiplash pappusgrass (*Pappophorum vaginatum* Buckl.) for southern Arizona. Whiplash pappusgrass is commonly known as Pima pappusgrass in southern Arizona.

As a selected release, this germplasm will be referred to as Pima Germplasm whiplash pappusgrass to document general collection location. It has been assigned the NRCS accession number 9064135. Pima Germplasm is released as a selected class of certified seed.

This alternative release procedure is justified by the lack of existing commercial sources of whiplash pappusgrass. Propagation material of this species is needed for ecosystem restoration and enhancement. The potential for immediate use is high. At present, there are no commercial releases of whiplash pappusgrass.

Species:	*Pappophorum vaginatum*
Common Name:	whiplash pappusgrass
Plant Symbol:	PAVA2
Accession Numbers:	9064135

Collection Site Information

Pima Germplasm is a composite of 16 accessions collected from native whiplash pappusgrass stands in southern Arizona (Table 1). Plant materials were collected from diverse areas in southern Arizona to develop a population of whiplash pappusgrass with a broad genetic base and adaptation to the area of its intended use.

Description

Whiplash pappusgrass is a native perennial warm season bunchgrass. It is found along roadsides, in valleys and on plains at low elevations. It occurs in the southwestern United States, Mexico, Argentina and Uruguay. In Arizona, whiplash pappusgrass is found primarily in Pima and Cochise Counties at elevations from 2,500 to 4,000 feet. Whiplash pappusgrass has erect culms, 25 to 40 inches (60-100 cm) tall. The leaf blades are 0.08 to 0.20 inches (2-5 mm) wide and flat with edges that may roll inward. The panicle is spike-like, 4 to 8 inches (10-20 cm) long, tawny or whitish and tapering at summit. Spikelets are short-pediceled with 1 or 2 fertile florets and 2 or 3 sterile reduced florets. The chromosome number is reported to be 2n = 60.

The mating biology of whiplash pappusgrass has not yet been determined. The general assumption is that it is either self-pollinated or apomictic. In self-pollinated or apomictic species, genetic recombination between different populations can be limited. This may limit the range of adaptation of the composite population to environments similar to those originally sampled. The total genetic variation of the composite population should still be greater than that of a single ecotype.

Table 1. Accession number and origin of collections for Pima Germplasm whiplash pappusgrass.

Accession Number	Collection Location	Comments
9064074	T24S, R28E, Sec. 12	Douglas, AZ
9064075	T19S, R19E, SE1/4 of SE1/4 of Sec. 24	Hwy 90 on Sands Ranch
9064076	T21S, R24E, SW1/2 of SE1/4 of Sec. 27	47 Ranch
9064077	T23S, R24E, SE1/2 of NW1/4 of Sec. 10	Lee Station Ranch
9064078	T17S, R20E, NE1/4 of NE1/4 of Sec. 7	
9064079	T13S, R20E, NE1/4 of NW1/4 of Sec. 26	Harris' VF Ranch
9064080	T8S, R2E, SE1/4 of Sec. 20	
9064081	Tohono O'odham Res.	near roadside
9064082	Tohono O'odham Res.	
9064083	16S, R10E, NW1/4 of Sec. 7	Three Points, AZ
9064106	T21S, R9E, NW1/4 of SW1/4 of Sec. 34	Chilton's Arivaca Ranch
9064124	T17S, R14E, NW1/4 of SE1/4 of Sec. 20	pasture 5N in SRER
9064125	T17S, R20E, NW 1/4 of Sec. 4	Benson, AZ
9064126	T24S, R28E, SE1/4 of NE1/4 of Sec. 17	Douglas, AZ
9064127	T20S, R20E, NW 1/4 of Sec. 6	2 mi. N of Mustang Corners
9064128	1920 W. Copper St., Tucson, AZ	undeveloped lot

Method of Selection

Pima Germplasm was developed from accessions collected from naturally occurring populations in southern Arizona. Germplasm was collected from the area of proposed use. Sixteen accessions were planted into a randomized complete block design at the Tucson PMC in 1999. Rows were spaced 42 inches apart. An experimental unit consisted of 10 plants. The seed harvested from this planting was the source of Pima germplasm. No

selection was made on the 16 accessions in order to maximize the genetic adaptability of the release.

Ecological Considerations

Pima Germplasm whiplash pappusgrass is a composite of naturally occurring germplasm and has undergone no purposeful selection. Pima Germplasm does not differ significantly in rate of spread, seed production, or vigor from naturally occurring whiplash pappusgrass. Pima Germplasm whiplash pappusgrass was determined "OK to release" when evaluated through the "Worksheet for Conducting and Environmental Evaluation of NRCS Plant Releases".

Anticipated Conservation Use

The potential uses of Pima Germplasm whiplash pappusgrass include erosion control, wildlife food/cover, restoration of disturbed areas, rehabilitation of rangeland and for increasing plant diversity in arid rangeland communities.

Anticipated Area of Adaptation

Pima Germplasm whiplash pappusgrass was developed for use in southern Arizona. Whiplash pappusgrass is naturally occurring along roadsides, in valleys and at low elevation on plains and dry open areas.

Availability of Plant Materials

Seed production will be maintained by the USDA-NRCS Tucson Plant Materials Center. Limited quantities of seed are available to seed producers for increase and to other interested parties as available.

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2. Gould, F.W. and R.B. Shaw. 1983. Grass Systematics. 2nd edition. Texas A&M University Press, College Station, Texas. p. 314.
3. Jones, T.A. and D.A. Johnson. 1998. Integrating genetic concepts into planned rangeland seedings. Journal of Range Management 51: 594-606.
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Signatures for release of:

Pima Germplasm Whiplash pappusgrass (*Pappophorum vaginatum*)

_____ _____

David McKay
Arizona State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Phoenix, Arizona

Date

_____ _____

Diane Gelburd
Director, Ecological Sciences Division
United States Department of Agriculture
Natural Resources Conservation Service
Washington, D.C.

Date

Bush Muhly Technology Development

STUDY NUMBER: AZPMC-T-0502-CR

Introduction

Bush muhly (*Muhlenbergia porteri* Scribn. Ex Beal.) is a warm season native perennial bush grass. Plants may reach up to 3 feet (1 m) in height and are highly branched. It occurs in desert grasslands, desert shrub, within interior chaparral and it is an understory component of evergreen woodlands. Distribution occurs from the southern Great Basin and Intermountain region south to California, Texas and Mexico. Bush muhly originally existed in extensive stands. It can be very susceptible to winter grazing and likely has retreated to areas where it is protected from grazing by shrubs. When bush muhly has sufficient moisture it does not die back to the root crown in winter, and new growth starts from near the base of the previous year's stems.

Materials and Methods

Transplants of bush muhly were grown in 5.7 cu. in. containers in the lathhouse at the PMC (Table 1). Six rows were established in a small border in September of 2005. The border was fertilized with 200 lbs/acre of ammonium sulfate (21-0-0) prior to planting. After plants had established the pre-emergent herbicide Oryzalin was applied.

When mature, this planting will be used to evaluate cultural practices related to seed yield, harvesting and seed processing. Bush muhly is a very desirable species for field plantings but is very expensive from commercial dealers. By investigating cultural practices involved in seed production, the price of this species will undoubtedly decrease, and increase its availability to the market.

Table 1. Accession number and collection location of 22 accessions in Bush muhly evaluation

Number	Accession Number	Collection Location	Number	Accession Number	Collection Location
1	9063997	-109.8041 31.3439	12	9064002	-113.3921 36.6943
2	9058830	-110.4192 33.5026	13	9092495	-109.7999 32.9979
3	9058798	-115.1658 37.4003	14	9092493	-109.8387 32.7485
4	9058796	-110.9347 32.4314	15	9058823	-110.0478 32.8528
5	9053587	-114.1672 33.0667	16	9058824	-110.0306 32.8239
6	9058822	-109.8597 32.8961	17	9058799	-111.5551 31.9883
7	9092494	-109.8482 31.7219	18	9058829	-110.4538 33.5026
8	9058801	-109.4328 32.6075	19	9058826	-109.1768 32.6940
9	9058763	-111.7583 31.7083	20	9058828	-113.3742 36.7088
10	9058800	-111.3772 31.8775	21	9058797	-111.8861 32.7172
11	9058825	-109.1611 33.0125	22	9058821	-111.6917 32.1972

Location of Collections in the Bush Muhly Technology Development Study

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Development of Technology for Seed Production of 'Stevan' Plains Bristlegrass

STUDY NUMBER: AZPMC-T-0405-CR
STUDY NUMBER: AZPMC-S-0702-CP

Introduction

Plains bristlegrass [*Setaria leucopila* (Scribn. & Merr.) K. Schum.] is a very desirable grass for restoration, providing good grazing for livestock and wildlife. 'Stevan' plains bristlegrass was released by the Tucson Plant Materials Center in 1994. 'Stevan' was selected for vigor and forage production. New plantings of 'Stevan' produced quality seed; however as the plantings aged seed fill reduced significantly. 'Stevan' was removed from production at the PMC because seed fill was extremely poor. The fact that young plantings of 'Stevan' produced viable seed indicates that the poor seed fill is not an intrinsic problem, but a cultural one. The objective of this study is to develop cultural practices for good seed production in plains bristlegrass.

Description

Plains bristlegrass is widespread and abundant in southern Arizona. It occurs at elevations from 2,000 to 7,000 feet (610 to 2,134 m). It is found growing in dry plains and washes, on rocky slopes, and often in partial shade of shrubs and trees.

Plains bristlegrass is a native, perennial, C_4, warm season bunchgrass. Culms are 16 to 47 inches (40 to 120 cm) tall, firm, wiry and bent sharply. The lower nodes are usually pubescent to hairy. The sheath is ciliate on the margins and with a tuft of hair on either side of the ligule. The ligule has a fringe of straight, stiff hairs. The panicle is dense and spikelike, 2 to 6 inches (5 to 15cm) long.

Materials and Methods

Thirteen accessions (Table 1) were planted in an initial evaluation planting (IEP) and observed from 1975-1979 and no significant differences were observed.

Seed from the 13 accession were blended to form the composite 'Stevan' (accession 9003939).

To re-establish 'Stevan' Plains bristlegrass transplants were grown in 5.7 cu. in. containers in the lathhouse at the PMC. Four rows were established in a small border in September of 2004. The border was fertilized with 200 lbs/acre of ammonium sulfate (21-0-0) prior to planting. After plants had established the pre-emergent herbicide Oryzalin was applied.

This planting continues to be evaluated for cultural practices with the potential to increase the seed viability and yield. This release continues to have low germination rates using traditional germination testing. In spring 2006, three separate harvest years 2003, 2005 and 2006 were tested for germination in containers in the greenhouse. Three replications of 100 seed per pot were planted in 5"x3" pots with 2" of potting soil. Very few seeds germinated in any of the lots. This release will continue to be tested in greenhouse experiments and field plantings to determine its true germination potential.

Table 1. Accession number and collection location of accessions used in the composite cultivar 'Steven'.

	Accession Number	**Collection Location**		**Accession Number**	**Collection Location**
1.	A-14266	Wilcox, AZ	8.	A-18173	Klondyke, AZ
2.	A-14539	Montezumas Well, AZ	9.	A-18174	Sasabe, AZ
3.	A-16535	Odessa, TX	10.	A-18176	Douglas, AZ
4.	A-17004	NM	11.	A-18294	Odessa, TX
5.	A-18170	Bowie, AZ	12.	A-18309	Douglas, AZ
6.	A-18171	Willow Springs Ranch, AZ	13.	A-18312	Klondyke, AZ
7.	A-18172	Tucson, AZ			

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2. Gould, Frank W. 1977. Grasses of Southwestern United States. University of Arizona Press, Tucson, Arizona. pp.270-271.
3. Pater, Mark. 1994. Notice of Naming and Release of 'Stevan' Plains Bristlegrass (*Setaria leucopila*). USDA, Soil Conservation Service, Tucson, Arizona. June 1994. 14p.
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5. Toole, V.K. 1941. Germination of seed of vine-mesquite, *Panicum obtusum*, and plains bristle-grass, *Setaria macrostachya*. Jour. Amer. Soc. Agron. 32:503-512.

6. USDA, Soil Conservation Service. 1984 Technical Guide, Section IV, Range Seeding Specifications. USDA, Soil Conservation Service, Phoenix, Arizona. Revised January 1984.
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Development of Technology for Seed Production of 'Sonora' Black Grama

STUDY NUMBER: AZPMC-T-0503-CR

Description

Black grama is a long lived native perennial grass. It is an important native range grass of the semiarid and arid desert rangelands of the southwest. Distribution stretches from Texas to southern California and from Mexico northward to Colorado, Wyoming and Utah. It has wiry, spreading stems reaching 8 to 24 inches (20 to 60 cm). The growth habit of black grama varies among regions, being primarily caespitose in some areas and to stoloniferous in others. Leaves are smooth, narrow, flexuous and mostly basal. Leaf blades are 1 to 3 inches (2 to 7 cm) long and 0.08 to 0.02 inches (0.5 to 2 mm) wide. The inflorescence is a panicle consisting of 3 to 8 spicate unilateral branches.

The primary mode of regeneration for black grama is through tilling and stoloniferous expansion. Black grama regeneration through seed is often sparse. In most years less than 20 percent of black grama florets produce viable seed. This poor seed set has been attributed to insect infestation. Insects collected from black grama stands from 1957 through 1960 included representatives from nine orders, 55 families, 109 genera and 120 species of insects. Control of insects may result in an up to 700% increase in florets that produce mature caryopsis.

Black grama once occurred in almost pure stands over extensive areas of southeastern Arizona, southern New Mexico, western Texas and into northern Mexico. Due to human and natural factors these stands are now far less extensive. The fact that black grama's primary reproduction is asexual means that existing stands of black grama spread slowly into adjacent areas. Black grama has not generally been used for reseeding because of characteristic poor seed production and scarcity of quality seed.

'Sonora' black grama [*Bouteloua eriopoda*(Torr.) Torr.] was released by the Tucson PMC in 1965. It was the first improved black grama cultivar to be released for commercial seed production. The cultivar was developed from 11 vegetative and 47 seed accessions collected from Arizona and New Mexico in 1957. At the time of release 'Sonora' was characterized as outstanding for leafiness, vigor, forage production, vegetative spread, seed set and seed production. However, seed production in subsequent years declined and 'Sonora' was abandoned due to poor seed yield. Subsequent research has provided information indicating that the reduction in seed yield was due to a build up of parasitic insects.

A 0.25 acre production field was reestablished at the PMC in 2005 to determine if agronomic and pesticide protocols could be developed that would make 'Sonora' a viable cultivar for southern Arizona and New Mexico.

Transplants were grown in 5.2 cu. in. forestry pellets and transplanted in September with a mechanical transplanter. The border was fertilized with 200 lbs/acre of ammonium sulfate (21-0-0) prior to planting. Following harvest, this planting will be used to evaluate cultural practices and insecticide treatments to determine if production of 'Sonora' is economically viable.

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Demonstration of Native Grasses

STUDY NUMBER: AZPMC-T-0301-CR

Introduction

A grass demonstration nursery was established at the Tucson Plant Materials center in 2003. This nursery consists of warm and cool season native plant material (Table 1). The nursery consists of Plant Material Program Releases adapted or presently used for plantings. This nursery is used for training and for informal evaluation.

Table 1. Plant Materials Releases in the Native Grass Demonstration Nursery

Common Name	Scientific Name	Release Name	Origin
Eastern Gamagrass	*Tripsacum dactyloides*	'Pete'	KSPMC
Indian Ricegrass	*Achnatherum hymenoides*	'Rimrock' 'Nezpar' 'Paloma'	MTPMC IDPMC NMPMC
Green Sprangletop	*Leptochloa dubia*	'Marfa'	TXPMC
Bottlebrush Squirreltail	*Elymus elymoides*	'Tusas' 'Sandhollow'	NMPMC ARSUT
Galleta Grass	*Pleuraphis jamesii*	'Viva'	NMPMC
Sand Bluestem	*Andropogon halli*	'Elida' 'Garden'	NMPMC KSPMC
Sideoats Grama	*Bouteloua curtipendula*	'Haskel' 'Vaughn' 'Niner'	TXPMC NMPMC NMPMC
Spike Dropseed	*Sporobolus contractus*	Potter County Germplasm	TXPMC
Arizona Cottontop	*Digitaria californica*	'Loetta'	AZPMC
Arizona Fescue	*Festuca arizonica*	'Redondo'	NMPMC
Switchgrass	*Panicum virgatum*	'Alamo' 'Kanlow' 'Blackwell'	TXPMC KSPMC KSPMC
Little Bluestem	*Schizachyrium scoparium*	'Cimmaron'	KSPMC
Blue Grama	*Bouteloua gracilis*	'Alma' 'Hachita'	NMPMC NMPMC
Big Bluestem	*Andropogon gerardii*	'Earl'	TXPMC
Alkali Sacaton	*Sporobolus airoides*	'Saltalk'	TXPMC
Cane Bluestem	*Bothriochloa barbinodis*	Saltillo Germplasm Grant Germplasm	AZPMC NMPMC
Sand Dropseed	*Sporobolus cryptandrus*	Borden County Germplasm	TXPMC
Black Grama	*Bouteloua eriopoda*	'Nogal' 'Sonora'	NMPMC AZPMC
Sand Lovegrass	*Eragrostis trichodes*	'Mason'	TXPMC
		'Bend'	KSPMC

Seed from each species were sown into cone-tainers (SC-10 super cells) in the greenhouse in March 2003. Each species was watered and fertilized as needed. In June the plants were transplanted to the field. Plants were planted in single rows 50 feet long with 40 inches between the rows. Material of the same species were planted adjacent to each other. The planting was fertilized with 100 lbs/acre of urea (46-0-0). Water was applied immediately after fertilization to prevent volitization of the urea as ammonia. After plants were established the pre-emergent herbicide Oryzalin was applied to prevent weeds and seedlings from the plants. Oryzalin is re-applied at 6 month intervals. The planting is watered and cultivated as needed. They are mowed 2 times per year.

Cool Season Grasses

None of the cool season grasses planted thrived and most did not survive the southern Arizona summer. Cool season grasses are not typically included in seeding mixes for southern Arizona. However, many land managers have expressed interest in including them in mixes at elevations above 2500 feet.

Bottlebrush squirreltail:

Tusas germplasm is superior to Sandhollow germplasm in this planting. The Sandhollow germplasm plants all died before September 2003. They did not survive the summer. Approximately 20% of the Tusas germplasm plants survived and produced seed in spring 2004. The surviving plants remained in 2005. In 2006 all plants have perished.

Indian ricegrass:

The cultivar 'Paloma' appears to be the better choice for southern Arizona. Even though it is very stressed by the summer heat, it continues to survive and produce seed. Neither 'Nezpar' nor 'Rimrock' survived the first summer. No plants of 'Paloma' survived through 2006

Warm Season Grasses

All warm season grasses have survived. The Eastern gamagrass seems to be perpetually chlorotic, probably due to the high soil pH. Big bluestem, sand bluestem and sand lovegrass are all struggling, but are surviving.

Sideoats grama:

'Vaughn' sideoats appears to be superior to 'Haskell' and 'Niner', as it is much more vigorous, and produces more vegetation. Haskell is gradually disappearing from the study, with only a few plants remaining in 2006.

Switchgrass:

All switchgrass cultivars are thriving. 'Alamo' produces the bigger plants.

Switchgrass Cultivars in 2004

Sand bluestem:

'Elida' is the more vigorous cultivar under the conditions of this trial. However, by 2006 most plants have disappeared.

Cane bluestem:

The cane bluestem germplasm Saltillo and Grant appear very similar. The Saltillo germplasm greens up approximately 2 weeks before Grant, however Grant produces more vegetation. In 2006 it appears that the Grant germplasm stand is thinning. The Saltillo stand is still strong.

Black grama:

'Sonora' is much more rhizomatous than 'Nogal' in this planting. 'Sonora' also seems to continue to grow throughout the summer season, where 'Nogal' appears to shut down during the hottest months. Seed from 'Sonora' mature earlier, perhaps before the monsoon rains.

Black Grama Cultivars

Sand lovegrass:

'Mason' is much more adapted to conditions in this trial than 'Bend'. In 2006 both stands are poor.

Although this trial was planted as a demonstration it is providing valuable information on the adaptability of various plant materials releases being planted in southern Arizona. It has also proven to be invaluable when discussing species variability with students, field office personnel and other PMC visitors.

Tucson Plant Materials Center Native Grass Demonstration Nursery

Audubon Ranch Fields at the Tucson PMC

STUDY NUMBER: AZPMC-T-06-08-CR

The Audubon Society's Appleton-Whittle Research Ranch outside Elgin, AZ, are committed to combating Lehmann and Boer lovegrasses (*Eragrostis lehmanniana and E. curvula*). Both exotic species have increased following a catastrophic fire in 2002. In the future, the Ranch may hold some of the last vestiges of native grasslands in southern Arizona.

The Ranch wanted to look at simplified land management uses following the good monsoon rains in 2005 that produced an above average native seed crop. We decided to do a mixed-species harvest, skip the seed processing step, and spread the seed the way it's done in nature. The Woodward flail-vac was used for harvesting to do as little damage as possible to the harvest site. The seed harvest included blue grama, black grama, hairy grama, sideoats grama, sprucetop grama, plains lovegrass, cane beardgrass, various Forbs and sub-shrubs.

The 150+ lbs of seed will be available for reseeding multiple test plots at the Ranch, as well as a mixed species border here at the PMC.

In 2006, seed from the Ranch was used to establish a species rich field. Production of haybales from this field will be used in projects using mulch as a method of propagule distribution. In 2006 this 1 acre field produced 48 bales weighing approximately 55 lbs. These bales will be used in 2007 projects on the ranch as well as on various PMC field plantings.

Mary harvests seed from native stands at the Audubon Research ranch in 2005 (above); Tyler established two borders at the PMC in 2006

Introduction of Native Species Diversity into Exotic Lovegrass infestations

STUDY NUMBER: AZPMC-T-0607-IN

STUDY NUMBER: AZPMC-T-0606-IN

Introduction

Much of Southern Arizona's diverse grasslands are increasingly threatened by the invasion of exotic lovegrasses, but little is known about their management or control, or the economic return from such efforts. In fall 2005, the Tucson PMC harvested seed from the abundant grasslands of the Audubon Societies' Appleton-Whittell Research Ranch in Elgin, Arizona. Using seed from that harvest, two replicated studies were initiated in 2006 on the Ranch to investigate the potential for patch establishment of native species into invasive-dominated sites of lehmann lovegrass (*Eragrostis lehmanniana*) and Boer lovegrass (*E. curvula*). Both of these species have been present in small quantities on the Ranch for years, but have become dominant over much of the range following the catastrophic Ryan fire in 2002.

Methods

Seed harvested from the ranch was minimally processed (once through the hammermill) for use in both projects. Multiple species of grasses and forb seed, including *Eragrostis intermedia, Bouteloua gracilis, B. hirsuta, B. eriopoda, B. curtipendula, B. chondrosioides, Bothriochloa barbinodis, Digitaria californica, Lycurus phleoides, Leptochloa dubia, Aristida spp., Sida filicaulis, Ipomoea coccinea, Viguiera annua, Convolvulus equitans* were identified in the seed mix. The harvest site was selected based on its low density of exotic grasses. Because the few Lehmann lovegrass patches at the site were avoided while harvesting, very little Lehmann lovegrass should have entered the mix.

Project 1: Lehmann lovegrass

One project was conducted in collaboration with both the University of Arizona and the research ranch to test different patch sizes for native species establishment in Lehmann lovegrass-dominated stands by herbicide and seeding. At four similar sites: three replications of three plot sizes, $1m^2$, $2m^2$ and $4m^2$ patches, were randomly placed within a 50 m area. In July the 24 plots were mowed with a weed eater, and 7 days later sprayed with 5% application of Glyphosate (Roundup). Following spraying, equal proportions of seed were spread evenly across all plots and raked in. The recommended range seeding rate of 20 seed/square ft (approx. 0.02 g seed/square ft) was doubled to increase the opportunity for germination.

PMC intern, Megan Otto, rakes in seed following spraying

Linda Kennedy (Audubon Society), Jeff Fehmi and Jason Stevens (University of Arizona) painstakingly examine each seedling in the $1m^2$ plot

Following the summer rains, every seedling observed in the plots were Lehmann lovegrass, the same exotic grass surrounding the plots. No native seedlings were observed in any of the plots. This project was unsuccessful because no conclusions could be drawn about small patch establishment of native species. The native grass seed broadcasted either disappeared (possibly consumed by granivores) or did not germinate in the plots. No data were analyzed for this study.

Project 2: Boer lovegrass

In a second project the PMC collaborated with the Research Ranch to reduce the dominance of Boer lovegrass and increase native diversity with the use of several cultural practices:

Mowing- with diesel tractor and rotary mower
Broad-spectrum herbicide- Roundup Ultra 5% rate and blue dye
Growth suppressant- Embark 2-S at 4 pints/ac and blue dye
Seeding- Native seed planted with FLXII Truax No-Till Grass Drill (4-5" depth)

Four replications of the following treatments were equal in size and arranged randomly in replicated complete block grid pattern (Figure 1):

- mow & herbicide & seed
- mow & growth suppressant & seed
- mow & seed
- seed only
- control

All 20 plots were 50 ft by 8 ft, with a 5 ft buffer around each plot to prevent overlap of treatments. The equipment was passed through each block to ensure uniformity of the treatments. Plots were delineated by colored rebar stakes.

The plots were set up and treated during the month of July. Four of the five treatments (16 plots) were mowed. Seven days later, four of the mowed plots were sprayed with herbicide, and another four of those plots were sprayed with a growth suppressant hormone. Three days following the spraying, four of the five treatments (all but the control plots) were

Plot pattern following mowing and spraying

seeded with a drill. Approximately 40 seed/sq ft were seeded in the plots, double the recommended range seeding rate to increase the opportunity of germination. Approximately 14.46 lb/ac was used in each of the drill's boxes (fluffy seed and small seed) for all plots combined. The growth suppressant hormone treatment was not effective due to multiple rainfall events. The treatment would have needed to be reapplied and was not, so this treatment was dropped from the study.

PMC interns Jace Householder and Megan Otto seed the plots.

Seedlings began to emerge following the summer rains July through September, and on October 19 the four active treatments in the Boer treatments were evaluated. Data were collected from within a 1 m x 0.5 m frame placed randomly twice in each plot. Seedlings were identified within and between the drill rows in each frame. The four treatments were evaluated according to the following variables:

- Mean frequency of native grass seedlings
- Mean frequency of mature native grasses
- Mean frequency of exotic grass seedlings
- Mean frequency of mature exotic grasses
- Mean frequency of perennial forb seedlings
- Mean frequency of mature perennial Forbs
- Mean species composition of seedlings
- Mean species composition of mature plants
- Vegetation cover in frame (using Daubenmire score)

Jennifer Arnold (NRCS Tucson Field Office), Linda Kennedy and PMC intern Leslie Wood and examine seedlings in the frame.

Frequencies of individual plants in the plots previous to treatment (mature native grasses, Forbs and exotic grasses) were recorded separately in each frame. Frequencies of native grass, forb and exotic grass seedlings were also counted in each frame using a seedling identification guide. Species composition was listed for mature plants and seedlings; these totals number represent the species composition variable. Cover was estimated in each frame using Daubenmire scores.

Results

The plots that were sprayed with herbicide had significantly lower cover scores than the plots that were not sprayed (p=0.0053). There was no difference in mean frequency of mature native grasses (p=0.147), exotic grasses (p=0.203) or mature Forbs (p=0.75) between treatments.

Species composition of mature plants in the plots was significantly lower in the sprayed plots (p<0.0005).

Table 1. Cover, Mature Grasses and Plant Composition following Treatment

Treatment	N	Vegetation Cover (%)	Species composition of mature plants (#)
Mow & Herbicide & Seed	8	11.63 b	0.25 b
Mow & Seed	8	45.25 a	6.28 a
Seed only	8	42.50 a	4.25 a
Control	8	53.13 a	5.38 a

Values followed by the same letter are not significantly different (α=0.05)
Randomized complete block AOV and LSD All-Pairwise Tukey Test were conducted.

A significantly greater number of native grass seedlings established in the sprayed plots than the control plots (p=0.023). Neither treatment differed significantly from those that were mowed and seeded or seeded only. A greater number of exotic grass seedlings established in the sprayed plots than the mowed plots, although this difference was not statistically significant (p=0.084). Of the 32 total plots examined, 3 plots had Boer lovegrass seedlings, and 8 plots had Lehmann lovegrass seedlings. Three of the eight plots containing Lehmann lovegrass seedlings were in the plots sprayed with herbicide. Numbers of forb seedlings did not differ between treatments.

Seedlings emerging from drill rows in a plot mowed, sprayed and seeded.

Species composition of seedlings was significantly greater in the sprayed plots than the other treatments (p=0.0003).

Table 2. Frequency and Composition of Seedlings Following Treatment

Treatment	N	Native grass seedlings (#)	Exotic grass seedlings (#)	Species composition of seedlings (#)
Mow & Herbicide & Seed	8	70.72 a	18.28	8.13 a
Mow & Seed	8	43.00 ab	0.75	4.35 b
Seed only	8	45.50 ab	5.38	2.75 b
Control	8	11.00 ab	5.88	2.87 b

Values follwed by the same letter are not significantly different (α=0.05)
Randomized complete block AOV and LSD All-Pairwise Tukey Test were conducted.

Discussion

The project that drilled seed into the soil (Boer lovegrass) rather than broadcast and raked into the soil (Lehmann lovegrass) allowed for differences to be demonstrated between treatments. The largest plots (4m x 4m) in the Lehmann lovegrass stands may have not been large enough to show an effect. Vulnerability to seed predators and wind is greater in smaller plots. In the Boer lovegrass study, the plots were not only larger but the seed drilled into the soil provided better protection from granivores and other sources of seed removal.

The Boer lovegrass study demonstrated several interesting findings, all of which were related to herbicide application. Herbicide use following mowing and seeding increased vegetation cover, produced the greatest native and exotic grass seedling increase, and the greatest seedling species composition.

These effects point in favor of native plant establishment. However, it may also provide optimum conditions for germination of exotic seed present in the soil. Herbicide removes preexisting plants at the site, which provides space and resources for the germination of a greater number and diversity of seedlings.

The increase in exotic seedlings can also be attributed to this decrease in plant cover. Because care was taken to avoid the patches of invasive species when the seed was harvested, the exotic seed must have been in the seed bank. Although the dominant species at the site, and presumably in the seed bank, was Boer lovegrass, Lehmann lovegrass apparently germinated more readily. The fact that a greater number of exotic grasses established in the plots that underwent herbicide application may be a cause of concern because any effort to establish native species will simultaneously increase the invasive species. Restoration efforts to increase native species diversity through herbicide, mowing and seeding will require follow-up of weed control.

The fact that numbers of previously existing plants did not differ between treatments suggests that the plots had low density initially. Plots with vegetation removal through use of herbicide did not differ from the plots with no removal of preexisting vegetation- in either native or exotic species. Hence, even a relatively small infestation of Boer lovegrass can have a large effect on the potential for establishing native species.

Mowing may have an additional effect. Fewer exotic seedlings established in the plots that were sprayed, seeded and mowed than those that were only mowed and seeded. In the process of mowing, the cut biomass is left on the ground, which has the effect of shading. This shading effect may prevent the establishment of exotic grass seedlings, which require light to germinate. By increasing the open canopy through herbicide application, the greatest number of exotic seedlings germinated, and by decreasing the open canopy by mowing, the fewest number of exotic seedlings established. Providing shade through mulch may decrease the prevalence of exotic seedling establishment, and hence may be an additional tool for increasing native diversity without the exotics.

Conclusion

The establishment of native species in stands of exotic grasses is effected by applied and existing factors. These studies indicate that more comprehensive studies are needed to establish methodology for seeding into stands of exotic grasses. Future studies will involve the use of hay bales harboring native seed.

Table 3. Species Composition in *Mow + Herbicide + Seed* Treatment

Block	Frame	Species- seedlings	Species- mature plants
A	1	*Grasses*- ERLE[1],ERIN,BOGR,LEDU,ARTE,LYPH *Forbs*- Croton, Sida NM, Dychariste, Evolvulus, Chaetopappa, Portulaca suffrutescens, Falls witchgrass (Digitaria cognata)	None
A	2	*Grasses*- ERLE[1],BOCU,ERIN,ARTE,DICA,BOHI	None
B	1	*Grasses*- DICA,ARHA,ERIN,BOGR,LEDU *Forbs*- Dychariste, Sida, Cudweed, daisy	None
B	2	*Grasses*- ERCU[1],ERIN,ARTE,BOCU *Forbs*- Dychoriste,Daisy, Cercium (thistle)	None
C	1	*Grasses*- ERIN,BOCU,LEDU,ARTE,DICA	ERCU[1], Dychariste gnaphalium
C	2	*Grasses*- ERLE[1],ERIN,LEDU,DICA,BOCH *Forbs*- Sida, Dychoriste, Evolvulus, bundleflower	None
D	1	*Grasses*- DICA,LEDU,BOGR *Forbs*- Cudweed, bundle flower, Mtn. caliandra, ragweed,evolvulus, dychoriste	None
D	2	*Grasses*- DICA,ARTE,ERIN,BOGR,LYPH *Forbs*- Daisy,Cudweed,Desert marigold, Conyzia	None

[1]Exotic grasses consisted of ERLE (Lehmann lovegrass) and ERCU (Boer lovegrass)
Native grass species consisted of ERIN (Plains lovegrass), LEDU (Green sprangletop), ARTE (Purple threeawn), ARHA (Spidergrass), LYPH (Common wolftail), DICA (Arizona cottontop), HIBE (Curly mesquite), BOBA (Cane beardgrass), BOGR (Blue grama), BOCU (Sideoats grama), BOCH (Sprucetop grama), BOER (Black grama).

Table 4. Species Composition in *Mow + Seed* Treatment

Block	Frame	Species- seedlings	Species- mature plants
A	1	*Grasses*- ARTE *Forbs*- Sida, Dychariste	*Grasses*- ERCU[1],BOCU *Forbs*- Hierba de pasmo, convolvulus, sida, evolvulus, ragweed, chaetopappa, mimosa
A	2	*Grasses*- ERLE[1],BOGR,ATRE,ERIN *Forbs*- Ragweed, Evolvulus, Dychoriste	*Grasses*- ERLE[1],HIBE,BOCU,BOGR,ERIN,ARTE,DICA,BOHI
B	1	*Grasses*- BOGR	*Grasses*- ERCU[1],BOGR *Forbs*- Dychoriste, Ragweed
B	2	*Grasses*- BOCU,ERIN, *Forbs*- Dychoriste,Mtn. Caliandra	*Grasses*- ERCU[1],BOGR *Forbs*- Evolvulus,Prostrate sida,Upright sida
C	1	No data	No data
C	2	*Grasses*- BOGR,ATRE,DICA,LEDU *Forbs*- Dychoriste, Portulaca, Daisy, Evolvulus,Hybanthus	*Grasses*- BOGR *Forbs*- Sida, Evolvulus, bundle flower, flame flower
D	1	*Forbs*- Ragweed, Dychoriste	*Grasses*- ERCU[1],BOER *Forbs*- Evolvulus, Dychoriste
D	2	*Forbs*- Dalea, bundleflower, Dychoriste	*Grasses*- ERCU[1],BOBA,BOCU,BOCH,ERIN *Forbs*- Dychoriste, Bundle flower, Upright sida, Portulaca suffrutescens

[1]Exotic grasses consisted of ERLE (Lehmann lovegrass) and ERCU (Boer lovegrass)
Native grass species consisted of ERIN (Plains lovegrass), LEDU (Green sprangletop), ARTE (Purple threeawn), ARHA (Spidergrass), LYPH (Common wolftail), DICA (Arizona cottontop), HIBE (Curly mesquite), BOBA (Cane beardgrass), BOGR (Blue grama), BOCU (Sideoats grama), BOCH (Sprucetop grama), BOER (Black grama).

Table 5. Species Composition in *Seed Only* Treatment

Block	Frame	Species- seedlings	Species- mature plants
A	1	*Grasses*- ERIN,ARTE,BOGR,DICA	*Grasses*- ERCU[1],BOGR
A	2	*Grasses*- ERIN,ARTE,BOGR	*Grasses*- ERCU[1],BOCU,BOGR *Forbs*- Dychoriste, Chaetopappa
B	1	*Forbs* - Dychoriste	*Grasses*- ERCU[1],ERLE[1],ERIN,BOCU,BOGR *Forbs*- Dychoriste, Evolvulus, bundleflower
B	2	*Grasses*- ERLE[1],ARTE	*Grasses*- ERLE[1], Panic grass *Forbs*- Evolvulus, Prostrate sida, bundle flower, Dalea
C	1	*Grasses*- ERLE[1],BOGR,LEDU,ERIN *Forbs*- Portulaca, Dychariste, Calliandra hymulus	*Grasses*- ERCU[1],BOGR *Forbs*- Dychariste, Evolvulus, Poinsetta radiens
C	2	*Grasses*- BOCU,BOGR *Forbs*- Sida, Portulaca, Dychoriste	*Grasses*- BOGR,BOCU *Forbs*- Sida
D	1	*Grasses*- BOGR	*Grasses*- ERCU[1]
D	2	*Grasses*- LYPH *Forbs*- Dychoriste	*Grasses*- ERCU[1],BOBA *Forbs*- Evolvulus, Chaetopappa

[1]Exotic grasses consisted of ERLE (Lehmann lovegrass) and ERCU (Boer lovegrass)
Native grass species consisted of ERIN (Plains lovegrass), LEDU (Green sprangletop), ARTE (Purple threeawn), ARHA (Spidergrass), LYPH (Common wolftail), DICA (Arizona cottontop), HIBE (Curly mesquite), BOBA (Cane beardgrass), BOGR (Blue grama), BOCU (Sideoats grama), BOCH (Sprucetop grama), BOER (Black grama).

Table 6. Species Composition in *Control*

Block	Frame	Species- seedlings	Species- mature plants
A	1	*Grasses*- BOGR	*Grasses*- ERCU[1],BOCU,BOGR
A	2	None	*Grasses*- ERCU[1],BOGR *Forbs*- Day Flower, Bundle flower, chaetopappa
B	1	*Forbs*- Cudweed, prostrate sida	*Grasses*- ERCU[1],BOCU *Forbs*- Daisy, Evolvulus, bundleflower, Prostrate sida
B	2	*Grasses*- ERLE[1] *Forbs*- Bundle flower, Mtn. Calliandra	*Grasses*- ERCU[1],ERLE[1],ERIN *Forbs*- Evolvulus, prostrate sida
C	1	*Grasses*- ERLE[1],ERCU[1],HIBE *Forbs*-Dychariste, Bundleflower, Sida NM	*Grasses*- ERCU[1],BOCU,HIBE,BOCH *Forbs*- Portulaca, Bundleflower, Sida
C	2	*Grasses*- ERCU[1], Unk. grama species *Forbs*- Dychoriste, Sida NM	*Grasses*- ERCU[1],BOGR *Forbs*- Unknown forb
D	1	*Forbs*- Dychoriste	*Grasses*- ERCU[1],BOGR,HIBE,BOCH,LYPH *Forbs*- Chaetopappa, Red maids, Bundleflower
D	2	*Forbs*- Portulaca suffrutescens, Dychoriste, Mtn. Caliandra, falls witchgrass, hybanthus	*Grasses*- ERCU[1],BOGR,BOER *Forbs*- Ragweed, Evolvulus

[1]Exotic grasses consisted of ERLE (Lehmann lovegrass) and ERCU (Boer lovegrass)
Native grass species consisted of ERIN (Plains lovegrass), LEDU (Green sprangletop), ARTE (Purple threeawn), ARHA (Spidergrass), LYPH (Common wolftail), DICA (Arizona cottontop), HIBE (Curly mesquite), BOBA (Cane beardgrass), BOGR (Blue grama), BOCU (Sideoats grama), BOCH (Sprucetop grama), BOER (Black grama).

Year two of Mojave Desert Project with BLM and High Desert RC&D

STUDY NUMBER: AZPMC-P-0401-CR
STUDY NUMBER: AZPMC-T-0403-CR
STUDY NUMBER: AZPMC-P-0404-CR
STUDY NUMBER: AZPMC-S-0601-CP
STUDY NUMBER: AZPMC-S-0701-CP

Year 2006, the second year of a reimbursable project with the BLM and High Desert RC&D, was focused on Vegas germplasm Alkali sacaton (*Sporobolus airoides* Torr.). Vegas germplasm was co-released by the NRCS Tucson Plant Materials Center and the BLM-Las Vegas Field Office as a selected class of certified seed. A second year of data was collected on the original G0 fields established during summer 2005. Both seed and hay bales were harvested from that field twice during the year. Production fields of this release (the G1 generation) were established at two locations in southern Nevada, as well as at the Tucson PMC in Arizona.

Increase Field of Alkali Muhly in June

A field of the second species of this project, Alkali muhly (*Muhlenbergia asperfolia*), which was established in late 2005, began the process of growing into a continuous sod in spring of 2006. Only at the end of the growing season in October of 2006 did seed mature, which suggests seed ripening for this species is day length sensitive.

Continued Evaluation of Foundation Field of Alkali sacaton

Second year of data collection at the PMC

Data were collected and analyzed on growth and reproductive characteristics of the G0 Alkali sacaton field for the second year. Again, only the two center rows were used for data collection and analyzed using Statistix (8.1). Randomized complete block AOV and LSD All-Pairwise Comparisons Tests were conducted.

In early April, informal observations of certain characteristics determined differences early in the growing season. Sacaton Canyon and Moapa accessions were the first to develop inflorescence stalks, thus were the earliest accessions to begin the reproductive process. Size classes continued to follow the trends of last year, with Sacaton Canyon visually largest, Pahranagat and Moapa medium-sized, and Ash Meadows the smallest.

Crossing block field of Alkali sacaton at the Tucson PMC

In May, a more formal evaluation of early reproductive stages of the four accessions were collected from all individual plants. Data were recorded on the presence of reproductive structures (inflorescence or flower) and presence of seed (Table 1).

Table 1. Early reproductive stages of the four accessions

Accession	Reproductive structures (inflorescence or flowers) [1] N=400	Seed presence (%) N=400
Moapa	2.95 a	90 a
Pahranagat	2.71 b	11 b
Ash Meadows	1.88 c	1 b
Sacaton Canyon	3.00 a	74 a

[1] Values fall along represent the a likert-like scale of least to greatest maturity, where 1=no inflorescence stalks, 2=presence of stalks, and 3=presence of flowering.
Values followed by the same letter are not significantly different (α=0.05)

Moapa and Sacaton Canyon were significantly more advanced in their reproductive season than Pahranagat, which was significantly further along than Ash Meadows. Not only were the majority of Moapa and Sacaton Canyon in the flowering stage in May ($p<0.0005$), but the majority were producing seed as well, significantly more than the other two locations ($p<0.0005$). These findings follow the same trends of the previous year.

Data collection also took place during mid-growing season (June) and the end of the growing season (September). Following methodology similar to the evaluation of the previous year, in June randomly selected individual plants from each 10-plant unit were clipped 3 in from the base of the plant in order to measure specific growth characteristics. This year weight, number of inflorescences and rust (scale of 1-6) were evaluated to compare the four accessions.

Leslie and Megan prepare a plant for evaluation

Table 2. Growth Characteristics of the four accessions

Accession	N	Weight (g)	Inflorescences (#)	Rust Score
Moapa	10	424 ab	89.3	2.6 a
Pahranagat	10	333 bc	87.5	1.5 b
Ash Meadows	10	249 c	48.5	3.3 a
Sacaton Canyon	10	533 a	92.8	2.3 ab

Values followed by the same letter are not significantly different (α=0.05)

Forage from Sacaton canyon plants was significantly heavier than Pahranagat and Ash Meadows (p=0.0014). Ash meadows had only about half the number of inflorescences than the other three accessions, although the difference was not significant (p=0.122). Moapa and Ash Meadows had significantly greater rust scores than Pahranagat (p=0.016), perhaps due to the shading effect of the larger accessions in the field. Data on seed maturity was collected during September prior to the seed harvest. All four accessions had mature seed, and no significant difference was found in amounts of mature seed per accession (p=0.9825). The consequence of this variable is crucial to the development of this species release, as genetic material from all four accessions needed to be transferred at harvest to develop the following generation of plants.

Mary inspects an inflorescence for presence of mature seed (June 2006)

Harvest of Plant Materials

Seed and hay bales were harvested from the foundation field; both are plant materials of value for commercial growers and land managers. Seed was harvested twice during the year: 10.5 lb in June and 11.8 lb in September. The field was mowed twice during the year, and the second cut was baled into 8 hay bales.

Seed was cleaned using the Hammermill, followed by the Clipper (Top screen 1/18, bottom screen 6 x 50). There was a noticeable difference in seed size when put through the clipper, so seed were separated into "small" and "large" seed, to ensure that equal amounts of each size were represented in the following generation of plants.

Leslie cleans Alkali sacaton seed with the clipper

Increase of Vegas Germplasm Alkali sacaton

Establishment of Commercial Production Fields in Nevada

Ramona and Megan assemble plugs into crates for transport to Nevada

Approximately 18,000 plugs of Vegas germplasm Alkali sacaton were grown in July to establish increase fields in Arizona and Nevada. Roughly equal numbers of "small" and "large" seed types were grown. During the week of September 25, plugs were transported from the Tucson PMC to two southern Nevada farms in Overton (in the Moapa Valley) and Pahrump. The two farms were selected to grow seed commercially for this project by the High Desert RC&D. Although they had no prior experience with native seed production, their enthusiasm was promising. Both farms were in close proximity to some of the original seed collections that were used to develop the release, and presumably, good adaptability for the seed (Fig 1). This is a pilot project, so the process of establishing first-time native seed growers through a collaborative project between two federal agencies and the local RC&D is completely experimental.

Planting at Sunrise Acres Farm in Pahrump

It was apparent immediately that inexperience in farming would require additional assistance by all of the partners involved. Explanation of field preparation remotely, through phone and email, was not sufficient. The first planting took place in Pahrump, at the size of 0.5 ac. unfortunately the soil was not ripped sufficiently (16 in) prior to the planting thus the plugs could not be planted efficiently with the planter. The great majority of plugs had to be re-planted by hand; limiting the planter's utility to spacing of plugs at 1.5 ft apart.

The planting at Moapa School of 1.5 ac was more encouraging; assistance was provided and the soil was properly prepared, however immediate problems were apparent. Although the soil was worked more deeply and the planter functioned at this location more efficiently, Bermuda grass, a noxious weed, had not been controlled and was distributed throughout the field. Although instructions had been given to kill the Bermuda grass by spraying the field prior to planting, the producer apparently assumed that disking the field would be sufficient. With trepidation on part of the partners, the planting took place, with instructions to keep the Bermuda grass out of the planting through manual control. Considering the labor force available at this farm (students), and the incentive payments provided to pay for it, this task would be difficult but still possible. The cooperators left the second site as frustrated as the first. A trip report was written describing the experience, as well as additional suggestions for each site to solve the current problems.

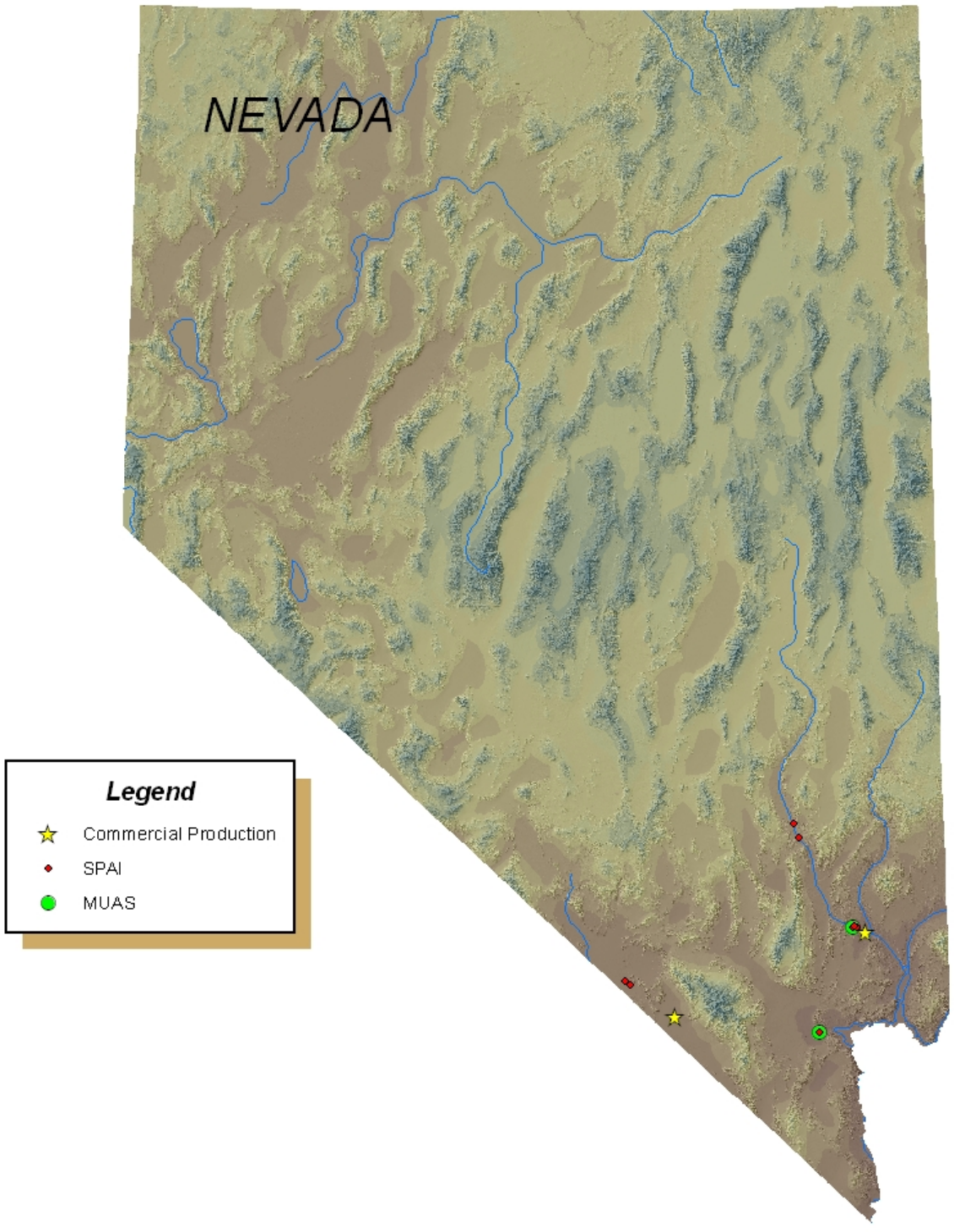
Students drove the tractor and used the planter at Moapa School

Increase Fields at the Tucson PMC in Arizona

Increase fields of Vegas germplasm alkali sacaton at the PMC (October 2006)

Far too many plugs were grown to use for the plantings in Nevada, so the majority of extra plugs were returned to the PMC. Sufficient plugs were available to plant two borders of a total of 0.65 ac of Vegas germplasm at the PMC in mid-October. Seed from this release would be available no matter what resulted at the new production fields in Nevada.

Figure 1. Alkali sacaton (*Sporobolus airoides*) and Scratchgrass (*Muhlenbergia aspirafolia*) collections and planting locations



THE UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
TUCSON PLANT MATERIALS CENTER
TUCSON, ARIZONA

AND

THE UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
LAS VEGAS FIELD OFFICE
LAS VEGAS, NEVADA

NOTICE OF RELEASE OF A SELECTION OF SCRATCHGRASS SELECTED CLASS OF GERMPLASM

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), and the U.S. Department of the Interior, Bureau of Land Management (BLM) announce the release of a selected class of scratchgrass (*Sporobolus airoides* (Torr.) Torr.) developed for use in southern Nevada.

As a selected release, this germplasm will be referred to as Vegas Germplasm scratchgrass to document general collection location. It has been assigned the NRCS accession number 9092744. Vegas Germplasm is released as a selected class of certified seed.

This alternative release procedure is justified by the lack of existing commercial sources of scratchgrass developed specifically for the Mojave Desert of southern Nevada. Propagation material of this species is needed for ecosystem restoration and enhancement in southern Nevada. The potential for immediate use is high. Current released cultivars of scratchgrass were developed from other areas of species adaptation. The cultivar 'Saltalk' was collected from Erick, OK and 'Salado' from Claunch, NM.

Species:	*Sporobolus airoides* (Torr.) Torr.
Common Name:	scratchgrass
Plant Symbol:	SPAI
Accession Numbers:	9092744

Collection Site Information

Vegas Germplasm is a composite of 4 accessions collected from native scratchgrass stands in southern Nevada (Table 1). Plant materials were collected from distinct locations at the peripheries of southern Nevada to develop a population of scratchgrass with a broad genetic base and adapted to the range of conditions in southern Nevada.

Description

Scratchgrass is a native, long-lived, warm-season, perennial bunchgrass. It reaches heights of 20 to 40 inches (50-100 cm). The panicles, nearly half the length of the plant, are stiff and

slender on widely spreading branches. Spikelets diverge from the panicles and have one flower. Seed fall readily from the spikelet when mature. The species is a facultative halophyte, having a broad tolerance to salinity. Scratchgrass reproduces from seeds and tillers. It blooms from April to May, producing seed from late summer to October. Plants produce abundant seed that remain viable for many years, in fact seed germination is best after ripening for a period of several months. In natural settings seed usually germinate in July after a 9-month after-ripening period. Scratchgrass grows in soil textures ranging from sand to clay, usually with low organic matter. Scratchgrass may grow in saline or nonsaline soils, often occurring in pure, dense, stands. It is common in moist alkaline flats, due to its adaptation to soils containing high sodium chloride concentrations and soils containing mixtures of other salts such as bicarbonate and sulfate compounds. On saline soils it is commonly found as a primary or secondary invader. After establishment, it is tolerant of both drought and inundation by water.

Table 1. Accession number and origin of collections for Vegas Germplasm scratchgrass

Composite Accession Number	Accession Number	BLM Number	Collection Site	Site Name
9092500	9092497	NV-052-0077R	N 36° 42.651 N 114° 42.630	Moapa
	9092498	NV-052-0055R	N 36° 42.271 N 114° 41.311	
	9092499	NV-052-0036R	Moapa NWR	
9092503	9092501	NV-052-0107R	N 37° 18’ 43.3” N 115° 7’ 34.7”	Pahranagat
	9092502	NV-052-0106R	N 37° 13’ 58.4” N 115° 5’ 25.8”	
	9092508	NV-052-0037R	Pahranagat NWR	
9092506	9092504		Ash Meadows NWR	Ash Meadows
	9092505	NV-052-0119R	Ash Meadows NWR	
9092507	9092507	NV-052-0043R	Sacaton Canyon	Sacaton Canyon

Method of Selection

Vegas Germplasm was developed from collections made at nine distinct sites within Clark, Lincoln and Nye Counties in southern Nevada. Accessions were planted in a 0.5 ac field at the PMC in June 2005. Plugs were planted into a latin square design to maximize hybridization between accessions. An experimental unit consisted of 10 plants. Seed were harvested 3 times during the growing season with the Woodward Flail vac seed stripper. For species like scratchgrass with indeterminate flowering, this process allows for multiple

harvests throughout the growing season. Multiple harvests insure that germplasm is represented in the new population regardless of time of maturity. The seed from the 3 harvests were combined to produce the Vegas germplasm of scratchgrass.

Ecological Considerations

Vegas Germplasm scratchgrass is a composite of naturally occurring germplasm and has undergone minimal purposeful selection. Vegas Germplasm does not differ significantly in rate of spread, seed production, or vigor from naturally occurring scratchgrass. Vegas Germplasm spike dropseed was determined "OK to release" when evaluated through the "Worksheet for Conducting and Environmental Evaluation of NRCS Plant Releases".

Anticipated Conservation Use

The potential uses of Vegas Germplasm scratchgrass include restoration and rehabilitation of riparian systems, wildlife habitat improvement, restoration of disturbed areas, and for increasing plant diversity in areas along the Virgin River and other lands in the southern Nevada area.

Anticipated Area of Adaptation

Vegas Germplasm scratchgrass was developed for use in the Mojave desert of southern Nevada. Scratchgrass is found naturally growing in sandy to clay soils. It may grow in saline or nonsaline soils.

Availability of Plant Materials

Seed production will be maintained by the USDA-NRCS Tucson Plant Materials Center. Limited quantities of seed are available to seed producers for increase and to other interested parties as available.

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Prepared by:

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Signatures for release of:

Vegas Germplasm Scratchgrass (*Sporobolus airoides*)

_____ _____

David McKay Date
Arizona State Conservationist
United States Department of Agriculture
Natural Resources Conservation Service
Phoenix, Arizona

_____ _____

Diane Gelburd Date
Director, Ecological Sciences Division
United States Department of Agriculture
Natural Resources Conservation Service
Washington, D.C.

_____ _____

Ted Angle Date
Nevada State Weed Program Coordinator
United States Department of the Interior
Bureau of Land Management
Reno, Nevada

Tucson Plant Materials Center and Saguaro National Park: Growing Native Plants

STUDY NUMBER: AZPMC-T-0614-CR

The Tucson Plant Materials Center (PMC) agreed to assist the Saguaro National Park (SNP), in revegetating the newly installed Cactus Loop Drive by growing and maintaining a variety of native species for the growing season of 2006.

In early April the first 914 plants – 16 species of trees, shrubs and forbs—were planted at the PMC (Table 1). Pots for these plants primarily consisted of the "small" and "large" pots (previously made by SNP of inverted black plastic tree pots with mesh bottoms), as well as "paper" pots (Zip sets held together in crates of 16) provided by the PMC. The PMC staff assisted a volunteer crew and 1-2 SNP employees in the soil mixing and preparation of pots and seeds for planting. SNP used a soil mixture of sand, peat and perlite, and all seed came from collections made in the East Region of the Park. Seed preparation instruction included scarification for some species, such as jojoba and acacia species. Approximately 37 crates of paper pots were also filled with soil for planting at a later date. This crew spent about 3 days at the Center in this activity, with only occasional assistance by the PMC staff.

In May an additional 617 plants—mostly grasses and some Forbs and trees—were planted by a SNP employee in the paper pots previously prepared by the volunteer crew. The total 1,531 plants required between 1½ and 2½ of the 6 shaded irrigable tables at the PMC during their 6 month stay. SNP reimbursed the PMC for the cost of water and other inputs and labor. The PMC was in charge of maintenance and reseeding of empty pots. Maintenance consisted primarily of the weekly clipping and fertilizing of plants throughout the growing season. Two PMC employees each spent 4-5 hours a week in this activity. Reseeding empty pots was required periodically. Some seed species were of better quality than others- and germinated easily. Others, such as the Palo verde seed, usually an easy species to propagate, required multiple reseedings.

Once summer rains increased and the plants grew, additional space and different requirements were needed for the various species, and plants were moved to accommodate them. The plants were overall robust and healthy. A few species suffered from aphids or other pests, and required additional attention. Most of these plants improved after treatment with a micro-encapsulated pyrethroid, however the mesquite trees suffered noticeably despite several treatments. Heavy summer rain may have caused over- watering of the mesquites and their increased vulnerability to infection, so these trees were removed to the greenhouse. The majority of plants survived, and in the end, the total number of mesquite trees exceeded the number requested, due to the fact that many pots harbored 2 plants per pot.

Because the building of the Cactus Loop drive was not finished by the anticipated date in October, the plants stayed at the PMC an extra month. This was not an issue as the growing season was coming to an end. The plants were put on a lower concentration of fertilizer in October and November. In November the plants were picked up by Recon, who was contracted for the planting. We hear the plants survived the cold period this winter and are doing well at the Park.

Table 1. Containerized Plants for Saguaro National Park Cactus Loop

Common Name	Scientific Name	Plant number	Container type*
Twinberry	*Menodora scabra*	44	12 S + 23 P
Desert tobacco	*Nicotiana trigonophylla*	4	S
Ocotillo	*Fouquieria splendens*	58	42 S + 16 P
Paper flower	*Psilostrophe cooperi*	40	S
Trixis	*Trixis californica*	51	S
Creosote bush	*Larrea tridenta*	36	S
Fairy duster	*Calliandra eriophylla*	25	S
Burroweed	*Isocoma tenuisecta*	100	84 S + 16 P
Desert senna	*Senna covesii*	29	13 S + 16 P
Desert cotton	*Gossypium thurberi*	16	16 S + 16 P
Brittlebush	*Encelia farinosa*	85	69 S + 16 P
Jojoba	*Simmondsia chinensis*	50	S
Desert zinnia	*Zinnia acerosa*	193	S
Foothills palo verde	*Cercidium microphyllum*	136	104 L + 32 P
Velvet mesquite	*Prosopis velutina*	177	145 L+ 32 P
White thorn acacia	*Acacia constricta*	55	30 L + 25 P
Catclaw acacia	*Acacia greggii*	32	P
Purple threeawn	*Aristida purpurea*	32	P
Bush muhly	*Muhlenbergia porteri*	32	P
Cane beardgrass	*Bothriochloa barbinodis*	48	P
Tanglehead	*Heteropogon contortus*	48	P
Arizona cottontop	*Digitaria californica*	32	P
Plains bristlegrass	*Setaria leucopila*	32	P
Slender grama	*Bouteloua repens*	32	P
Sideoats grama	*Bouteloua curtipendula*	48	P
Mormon tea	*Ephedra trifurca*	14	P
Globemallow	*Sphaeralea ambigua*	11	P
Desert hackberry	*Celtis pallida*	32	P
Turpentine bush	*Ericameria laricifolia*	8	P
Santa Catalina Prairie Clover	*Dalea pulchra*	16	P
Pringle's Prairie Clover	*Dalea pringlei*	16	P

*Container type:
S= small container (9" tall x 4"x 4" bottom and 3"x 3" top) ~0.4gallon
L= large container (13" tall x 4"x 4" bottom and 3"x 3" top) ~0.65 gallon
P= Paper container (9" tall x 3"x 3") ~0.33 gallon

Santa Rita Experimental Range: Buffelgrass Control in PMC Exclosure

STUDY NUMBER: AZPMC-T-0612-IN

Jace sprays the infestation of buffelgrass in an exclosure on the Santa Rita Experimental Range

Since near the time the Tucson Plant Materials Center was established in the 1930s, a 13 ac exclosure on the Santa Rita Experimental Range (SRER) was provided to the Tucson PMC to test plant materials from the Center. The site is conveniently located, near Sahuarita, which is about a 45 minute drive south of the Center. The SRER is a research facility established in 1903 to study the effects of grazing and livestock production on semidesert rangelands, once administered and managed by the US Forest Service, and currently by the University of Arizona's College of Agriculture. A good working relationship was established between the organizations. Until the mid-80s this plot was used year after year with a variety of different materials, disked, and used again in following years. Use of the plot by the PMC diminished following that period, a time which is characterized by active interest in "improvement of the range" – be it native or exotic – whatever would establish in these arid grasslands and provide good nutrition to wildlife and cattle. In 1985 a plot of Buffelgrass (*Cenchrus ciliaris*), an exotic grass from South Africa, was planted in the center of the exclosure as one of 20 accessions of plant materials to be tested. In the following years, the Buffelgrass plot, once 8 ft wide by 205 ft long, began to spread. By 2001 it was reported, "Buffelgrass has invaded and taken over most of the center of the site." (Bruce Munda, SRER log book, 1/31/2001) In successive years a monoculture has covered over half the exclosure as well as beyond the fence line. Buffelgrass has not only spread at this site, but in recent years has noticeably spread across southern Arizona, particularly along roadsides and southern facing hillsides.The Tucson PMC has changed its purpose from "improvement" of rangelands to "restoration" of rangelands, with exclusive use of native, preferrably local or regional, materials. In August 2006, the University of Arizona and the Tucson PMC agreed it was time to contain the buffelgrass infestation in the test plot. Three days of spraying over a period of a month, using a variety of equipment and multiple individuals, addressed the infestation.On the first day, the tractor was used for spraying. The tractor with an 8 ft boom required a driver and two additional people for directing the tractor movement to assure good coverage. 130 gallons of 5% Roundup solution was used to cover approximately 7 ac, the area of densest infestation. The infestation was located with GPS, which was centered in the exclosure, but also spread to nearby washes and roads. For the following two days of work only ATV and backpacks were used to spray the satellite locations.

The first two visits occurred during the monsoon period, when the plants were growing vigorously. By the third visit a month later, the Buffelgrass was yellowing, entering dormancy. The first two days of spraying killed the Buffelgrass but we were not convinced about the third. The Tucson PMC has agreed to return for 2 more years, as budget and personnel permits, to remove the Buffelgrass infestation altogether.

Due to the success of the buffelgrass kill in the 13 ac plot, the University of Arizona has set up a committee to survey and eradicate all Buffelgrass from the roads of the SRER. Technical assistance on spraying and planning was provided by the PMC. The PMC created a document to help guide the UA team efforts to demonstrate the cost efficiency using different types of equipment (see Table 1).

Ramona rejoices at her success two weeks after spraying Buffegrass (June 2006)

Table 1. Tucson PMC Recommendations to University of Arizona for Buffelgrass control

Implements	Tractor work		ATV or Backpack	
	Need per day	**$ for 7 ac**	**Need per day**	**$ for 1.5 ac**
Tractor	150	150		
Tractor sprayer	50	50		
Backpack			50	
ATV w/sprayer			50	50
Roundup (5%)	12gal/200gal H_2O x $45/gal [1]	540	$45/gal x 3gal/100gal H_2O [3]	135
Labor	3 people x 8hr x $30/hr [2]	720	2 people x $30/hr x 10 hr	600
Dye	0.25gal x $32/gal	8	3 "glug"s/100gal H_2O	2
Surfactant or soap	3gal Surf/200gal H_2Ox $20/gal	60	1.5gal/100gal H_2O	30
Gas/mileage	$1/mi x 90mi	90	$0.50/mi x 90mi	45
		Total:		Total:
		1618		862
$ Per ac:		**231***		**574***
$ For 1000 ac on SRER:		**231,000**		**574,000**

***Suggested lower cost options:**

Tractor work:

[1] Either: (A) Decrease Roundup rate to 3-4% or (B) increase acreage sprayed per volume solution by using finer spray nozzels
(A) At 4%: $45 x 9.6gal =$432 for Roundup per 7ac (total **$215/ac**)
(B) Increase acreage sprayed from 7 to 10ac (Total **$155/ac**)

[2] Use implements (ie. Foam) rather than the two assistants- $30/hrx 8hr x 1pers=$240 for labor + $50 foam (Total **$170/ac**)

ATV work:

[3] Decrease Roundup rate to 3% - $45/gal x 2.4gal = $108 for Roundup per 1.5ac (Total **$557/ac**)

Evaluation of Accessions of Sideoats Grama from Southeastern Arizona (MLRA 41)

STUDY NUMBER: AZPMC-P-0601-CR

STUDY NUMBER: AZPMC-T-0601-CR

Description

The sideoats grama (*Bouteloua curtipendula* [Mitchx.] A. Gray) initial evaluation planting (IEP) consists of 36 accessions, collected from Major Land Resource Area (MLRA) 41 the Southeastern Arizona Basin and Range in southeastern Arizona and southwestern New Mexico. This area is a transition between the Chihuahuan and the Sonoran Desert regions. The plant selection study is designed to evaluate the genetic diversity among populations of sideoats grama in this area. The technology development study will evaluate and develop production techniques and develop a protocol for commercial use of any potential release.

Objectives of these studies are:

1. Evaluate the diversity among accessions in this collection.
2. Evaluate phenotypic characters of accessions in this collection.
3. Develop production protocols.
4. Determine yield potential of seed and forage.
5. Produce a selected release for MLRA 41.

Duration of Study: 2006 through 2010

Study Leaders: Ramona Garner and Mary Hershdorfer

Location: Tucson Plant Materials Center, Tucson, Arizona

Introduction

Sideoats grama is a native, warm season perennial bunchgrass (Kearney et.al., 1960). Leaves are bluish green with heights of 3 to 39 inches (50-160 mm) and in southern Arizona occur in large clumps arising from a single root system (Kearney et. al, 1960). The stems occur in large or small clumps and are stiff and upright. The blades are usually narrow, up to 0.9 inches (2.5 mm) wide. Panicles have 12-80 branches, averaging 2-7 spikelets per branch. The glumes and lemmas are usually bronze or straw-colored to green but may occur in various shades of purple. The anthers are usually yellow or orange, but are occasionally red or purple. The chromosome number for *Bouteloua curtipendula* var. *caespitosa* is reported to be 2n = 58-103. (Flora of North America, 2003)

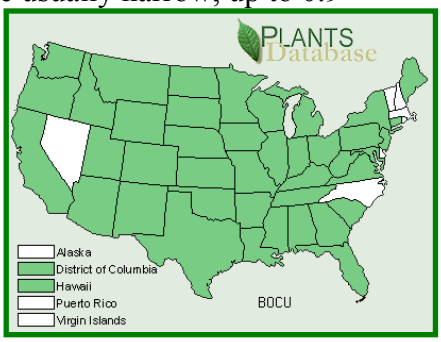


Fig. 1. Distribution of Sideoats Grama in North America

Sideoats grama is one of the most widely distributed warm season grass in the United States (Gould, 1979) (Fig. 1). In the West, sideoats grama generally occurs in loose, sandy or rocky, well drained limey soils. It is a major species in the desert grasslands of the southwest. Sideoats grama most often

occurs as a component of diverse grassland. It rarely occurs as a monoculture (Newell, et.al., 1962; Ruhle and Young, 1997).

There are two recognized varieties of sideoats grama, *Bouteloua curtipendula* var. *curtipendula* and *Bouteloua curtipendula* var. *caespitosa*. These varieties are most often distinguished by their area of occurrence. *Bouteloua curtipendula* var. *curtipendula* is distinguished by its ability to spread by rhizomes and is found in the northern range of the species. Sideoats grama in the southwestern United States is primarily *Bouteloua curtipendula* var. *caespitosa* (Smith, 1998). None of the accessions in this study are rhizomonous and thus are considered to be *Bouteloua curtipendula* var. *caespitosa*.

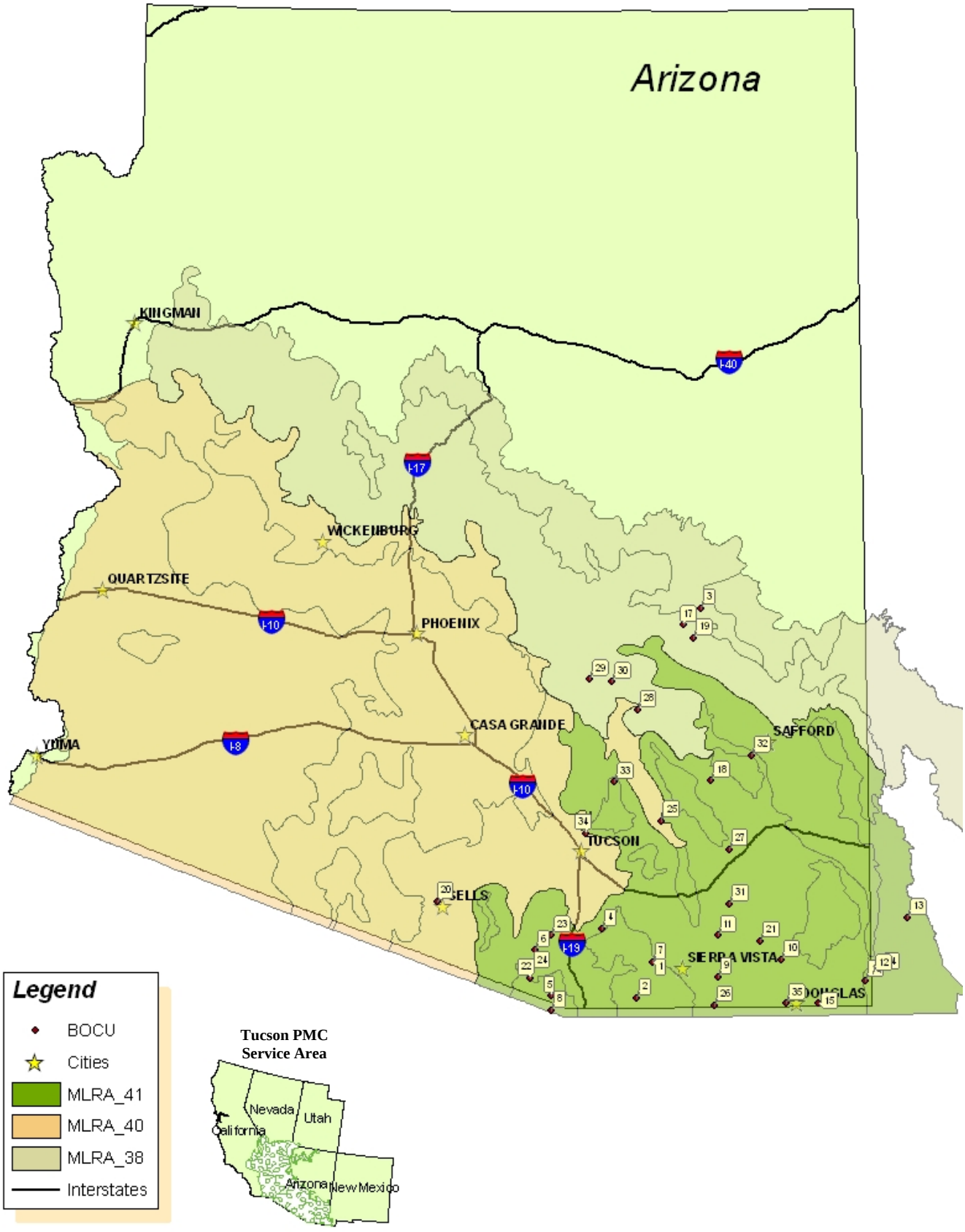
Bouteloua curtipendula var. *caespitosa* is considered to be apomictic through apospory (Gould, 1959; Mohamed and Gould, 1966). In apomictic species seed is formed asexually. The embryo develops in the ovary, as in sexually reproducing plants, but the embryo is formed without union of a sperm and egg. Even though this variety of sideoats does not reproduce sexually there is evidence of extensive variation within and among stands (Smith, 1998).

Materials and Methods

Thirty six accessions from MLRA 41 (Table 1) were grown in 35mm Jiffy forestry pellets in the greenhouse for 6 weeks. They were planted in July 2006 into a randomized complete block design (RCB)with 8 replications. Each experimental unit consists of 10 individual plants. Extra plants and accessions were used to fill in the field. Plugs were planted into the field 18 inches apart with 40 inch centers. Extra accessions were planted at the end of the plot to fill out the field. A pre-plant application of 100 lbs/acre of ammonium phosphate (11-48-0 $[NH_4)_3PO_4]$) was applied and the planting is irrigated as needed.

Results

In future growing seasons the accessions will be evaluated for characters such as size, flowering date, germination and vigor. Agronomic techniques will be evaluated to determine yield potential of seed and forage.



Location of Collections in Sideoats Grama Studies

Table 1. Accession number and collection location of 36 accessions in initial evaluation of Sideoats grama.

Number	Accession Number	Collection Location	Number	Accession Number	Collection Location
1	9092528	-110.5019 31.5901	19	9092705	-110.10110 32.6214
2	9092550	-110.6040 31.3874	20	9092718	-110.2139 33.4317
3	9092551	-110.1578 33.6033	21	9092737	-111.9331 31.9331
4	9092579	-110.99142 33.14354	22	9092519	-109.7803 31.7072
5	9092581	-110.8326 31.7811	23	9092588	-111.3131 31.5000
6	9092582	-111.1728 31.3992	24	9092613	-111.1711 31.7442
7	9092599	-111.2792 31.6597	25	9092616	-111.3078 31.5381
8	9092604	-110.5019 31.5901	26	9092641	-110.4411 32.3958
9	9092623	-111.1711 31.3175	27	9092518	-110.0934 31.3439
10	9092651	-110.0664 31.5033	28	9092555	-109.9865 32.2312
11	9092654	-109.6467 31.5997	29	9092553	-110.5941 33.0269
12	9092660	-110.0661 31.7411	30	9092759	-110.9177 33.2013
13	9092667	-109.0356 31.5111	31	9092580	-110.7668 33.1862
14	9092672	-108.8011 31.8253	32	9092538	-109.9855 31.9191
15	9092674	-108.9850 31.5169	33	9092517	-109.8280 32.7613
16	9092682	-109.3992 31.3508	34	9092521	-110.7500 32.6167
17	9092694	-109.0908 31.4747	35	9092520	-110.9461 32.3252
18	9092704	-110.2814 33.5078	36	9092578	-109.6167 31.3500

Literature:

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Evaluation of Accessions of Plains Lovegrass from Southeastern Arizona (MLRA 41)

STUDY NUMBER: AZPMC-P-0603-CR

STUDY NUMBER: AZPMC-T-0603-CR

Description

The plains lovegrass (*Eragrostis intermedia* A.S. Hitchcock) initial evaluation planting (IEP) consists of 30 accessions, collected from Major Land Resource Area (MLRA) 41 the Southeastern Arizona Basin and Range in southeastern Arizona and southwestern New Mexico. This area is a transition between the Chihauahuan and the Sonoran Desert regions. The plant selection study is designed to evaluate the genetic diversity among populations of Plains lovegrass in this area. The technology development study will evaluate and develop production techniques and develop a protocol for commercial use of any potential release.

Objectives of these studies are:

1. Evaluate the diversity among accessions in this collection.

2. Evaluate phenotypic characters of accessions in this collection.

3. Develop production protocols.

4. Determine yield potential of seed and forage.

5. Produce a selected release for MLRA 41.

Duration of Study: 2006 through 2010

Study Leaders: Ramona Garner and Mary Hershdorfer

Location: Tucson Plant Materials Center, Tucson, Arizona

Introduction

Plains lovegrass is a native, warm season perennial bunchgrass (Kearney et.al., 1960). Seed stalks are wiry and erect with heights of 1.2 to 3.5 inches (30-90 mm) (Kearney et. al, 1960). The leaf blades are usually narrow and up to 12 to 35 inches (10-25 cm) long. The inflorescence is an erect, diffuse, panicle 6 to 14 inches (15-35 cm) long. The spikelets have 3 to 9 flowers (Hitchcock, 1951). The seed is very small rectangular-prismatic and reddish brown. Plains lovegrass has had various chromosome numbers reported; 2n = ca. 54, 60, 72, ca., 74, 80, 100, 120. (Flora of North America, 2003)

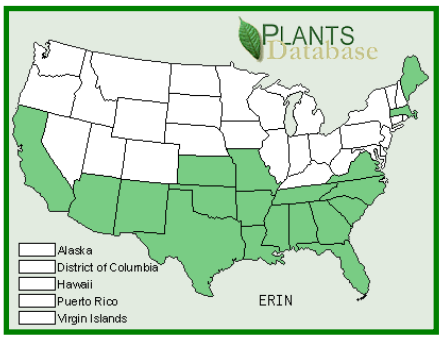

Fig. 1. Distribution of plains lovegrass in North America

Plains lovegrass occurs from Florida west to Arizona and extends north into Missouri and Kansas and south into scattered localities in Central America (Gould, 1979) (Fig. 1).

Plains lovegrass occurs on clay, sandy and rocky soils and often on disturbed sites, at 0 to 6069 feet (0 to 1850 m) elevation. In Arizona plains lovegrass occurs at elevations from 3,800 to 6,000 feet (1066 to 1800 m). Plains lovegrass will grow in most soil textures

(Canfield, 1948 and Frost and Smith, 1991). In southern Arizona it is most productive on sandy and sandy loam soils with poorly developed profiles and least productive on shallow, rocky soils. Plains lovegrass often grows in areas where annual precipitation is bimodal, with a wet season in winter and another in summer, when the bulk of the forage is produced. Mean annual precipitation in areas where plains lovegrass grows productively usually exceeds 15 inches (400 mm). (Wallmo, 1955)

Plains love grass produces quality forage on the grazing lands of Arizona and New Mexico (Gould, 1977 and Hitchcock, 1951). Because of its high seed stalk to forage ratio it does not produce a lot of forage. Plains lovegrass is considered to provide forage that is intermediate in preference to cattle. It is often heavily grazed since it is often the first species to green up in spring. In areas rested from grazing, Plains lovegrass increases, but decreases on areas where grazing occurs.

Materials and Methods

Twenty nine accessions from MLRA 41 (Table 1) were grown in 35mm Jiffy forestry pellets in the greenhouse for 6 weeks. They were planted in July 2006 into a randomized complete block design (RCB)with 9 replications. Each experimental unit consists of 8 individual plants. Plugs were planted into the field 18 inches apart with 40 inch centers. Extra accessions were planted at the end of the plot to fill out the field. A pre-plant application of 100 lbs/acre of ammonium phosphate (11-48-0 $[NH_4)_3PO_4]$) was applied and the planting is irrigated as needed.

Results

In future growing seasons the accessions will be evaluated for characters such as size, flowering date, germination and vigor. Agronomic techniques will be evaluated to determine yield potential of seed and forage.

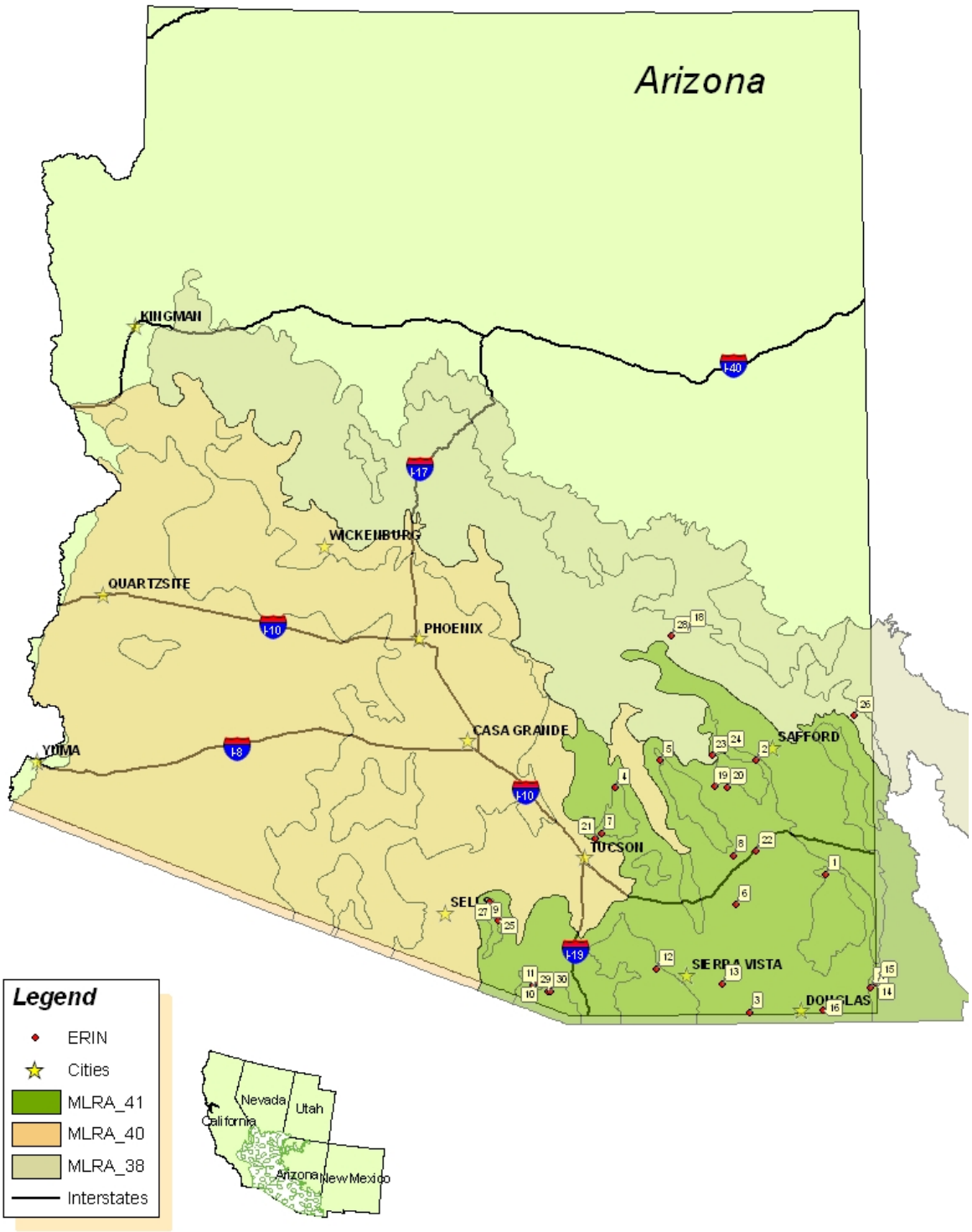
Arizona
KINGMAN
WICKENBURG
QUARTZSITE
PHOENIX
YUMA
CASA GRANDE
TUCSON
SAFFORD
SIERRA VISTA
DOUGLAS
I-40
I-17
I-10
I-8
I-19
Legend
ERIN
Cities
MLRA_41
MLRA_40
MLRA_38
Interstates
Nevada
Utah
California
Arizona
New Mexico

Table 1. Accession number and collection location of 30 accessions in initial evaluation of Plains lovegrass.

Number	Accession Number	Collection Location	Number	Accession Number	Collection Location
1	9092484	-109.3711 32.1175	16	9092686	-109.3992 31.3508
2	9092485	-109.8257 32.7662	17	9092692	-109.0908 31.4747
3	9092486	-109.8892 31.3439	18	9092703	-110.2814 33.5106
4	9092487	-110.7667 32.6167	19	9092709	-110.1011 32.6214
5	9092496	-110.4697 32.7712	20	9092716	-110.0214 32.6161
6	9092535	-109.9667 31.9500	21	9092743	-110.9000 32.3333
7	9092543	-110.8612 32.3607	22	9063991	-109.8320 32.2529
8	9092563	-109.9865 32.2312	23	9058812	-110.1160 32.7951
9	9092573	-111.6147 31.9585	24	9058768	-110.0306 32.8240
10	9092586	-111.3047 31.5089	25	9058769	-111.5469 31.8636
11	9092587	-111.3131 31.5000	26	9058770	-109.1610 33.0124
12	9092600	-110.5019 31.5901	27	9058806	-111.6067 31.9736
13	9092647	-110.0664 31.5033	28	9058771	-110.3846 33.4737
14	9092671	-109.0517 31.4978	29	9047438	-111.2167 31.4667
15	9092673	-109.0356 31.5111	30	9047439	-111.2000 31.4667

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Frost, W.E. and E.L. Smith. 1991. Biomass productivity and range condition on range sites in southern Arizona. Journal of Range Management. 44(1): 64-67.

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Hitchcock, A.S. 1951. Manual of the Grasses of the United States. Misc. Publ. No. 200 Washington, DC; U.S. Department of Agriculture, Agricultural Research Administration.

Kearney, T.H., R.H. Peebles, J.T. Howell and E. McClintock. 1960. Arizona Flora. 2nd ed. Berkeley, CA; University of California Press.

Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean and the Pacific Basin. 2006. USDA Handbook 296. USDA-Natural Resources Conservation Service. Washington, DC.

Wallmo, O.C. 1955. Vegetation of the Huachuca Mountains, Arizona. American Midland Naturalist. 54: 466-480.

Evaluation of Accessions of Bush Muhly from Southeastern Arizona (MLRA 41)

STUDY NUMBER: AZPMC-P-0602-CR

STUDY NUMBER: AZPMC-T-0602-CR

Description

The Bush muhly (*Muhlenbergia porteri* Scribn. ex Beal) initial evaluation planting (IEP) consists of 14 accessions, collected from Major Land Resource Area (MLRA) 41 the Southeastern Arizona Basin and Range in southeastern Arizona and southwestern New Mexico. This area is a transition between the Chihauahuan and the Sonoran Desert region. The plant selection study is designed to evaluate the genetic diversity among populations of bush muhly in this area. The technology development study will evaluate and develop production techniques and develop a protocol for commercial use of any potential release.

Objectives of these studies are:

1. Evaluate the diversity among accessions in this collection.

2. Evaluate phenotypic characters of accessions in this collection.

3. Develop production protocols.

4. Determine yield potential of seed and forage.

5. Produce a selected release for MLRA 41.

Duration of Study: 2006 through 2010

Study Leaders: Ramona Garner and Mary Hershdorfer

Location: Tucson Plant Materials Center, Tucson, Arizona

Introduction

Bush muhly is a native, drought resistant, warm season perennial bunchgrass (Kearney et.al., 1960). Seed stalks are slender, wiry, abruptly bent, multi-branched, with many nodes and short internodes with heights of 9.8 to 39 inches (25-100 cm) (Gould, 1979). The inflorescence is 1.6 to 5.5 inches (4-14 cm) long and 2.4 to 5.9 inches (6-15 cm) wide and usually purple at maturity. The seed is 0.07 to 0.09 inches (2-2.4 mm), oblong, compressed and yellowish-brown. Chromosome numbers reported for bush muhly are 2n = 20, 23, 24, 40. (Flora of North America, 2003)

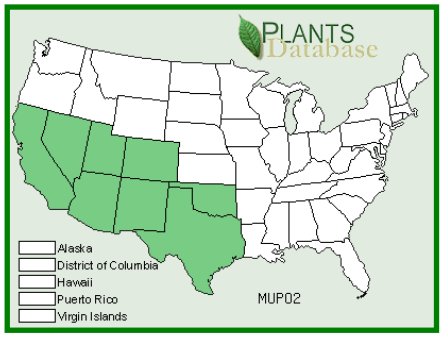


Fig. 1. Distribution of bush muhly in North America

Bush Muhly generally occurs in low elevation semi-desert and desert grasslands. It occurs on rocky or sandy sites on lower plains, dry mesas, canyons, foothills and open roadsides from 760 to 4,300 feet (230-1300 m). (Gould, 1979). Bush muhly originally existed in extensive stands, but due to its preference by cattle is now generally found growing under the protection of shrubs (Welsh, 1976). Bush muhly may decrease greatly on heavily grazed

rangeland, but may be a substantial component of mesa rangelands where they are in the process of recovery.

Materials and Methods

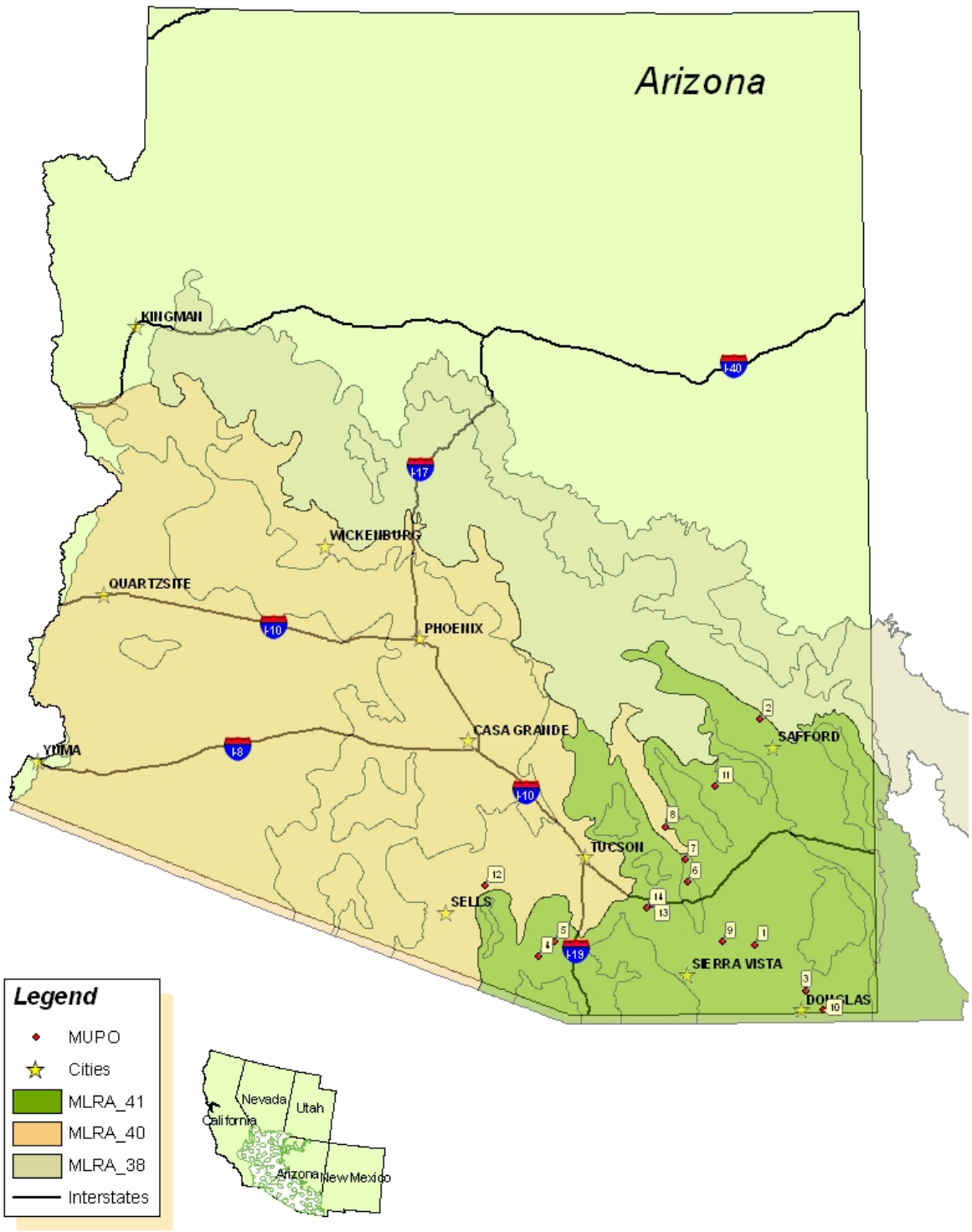
Eight accessions from MLRA 41 (Table 1) were grown in 35mm Jiffy forestry pellets in the greenhouse for 6 weeks. They were planted in July 2006 into a randomized complete block design (RCB) with 18 replications. Each experimental unit consists of 8 individual plants. Plugs were planted into the field 18 inches apart with 40 inch centers. Extra accessions were planted at the end of the plot to fill out the field. A pre-plant application of 100 lbs/acre of ammonium phosphate (11-48-0 $[NH_4)_3PO_4]$) was applied and the planting is irrigated as needed.

Results

In future growing seasons the accessions will be evaluated for characters such as size, flowering date, germination and vigor. Agronomic techniques will be evaluated to determine yield potential of seed and forage.

Table 1. Accession number and collection location of 14 accessions in initial evaluation of Bush muhly.

Number	Accession Number	Collection Location
1	9092494	-109.8482 31.7219
2	9092495	-109.7999 32.9979
3	9092574	-109.5148 31.4598
4	9092594	-111.2792 31.6597
5	9092621	-111.1711 31.7442
6	9092626	-110.2942 32.0792
7	9092631	-110.3061 32.2064
8	9092636	-110.4411 32.3958
9	9092666	-110.0661 31.7411
10	9092680	-109.3992 31.3508
11	9092708	-110.1011 32.6214
12	9092721	-111.6389 32.0586
13	9092727	-110.5331 31.9542
14	9092734	-110.5611 31.9331


Arizona
KINGMAN
I-40
I-17
WICKENBURG
QUARTZSITE
I-10
PHOENIX
YUMA
I-8
CASA GRANDE
I-10
SAFFORD
TUCSON
SELLS
I-19
SIERRA VISTA
DOUGLAS
Legend
MUPO
Cities
MLRA_41
MLRA_40
MLRA_38
Interstates
Nevada
Utah
California
Arizona
New Mexico

Literature:

Flora of North America, Vol 25, 2003. Ed. Barkworth, M.E., K.M. Capels, S. Long, and M.B. Piep, Oxford University Press, New York.

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Hitchcock, A.S. 1951. Manual of the Grasses of the United States. Misc. Publ. No. 200 Washington, DC; U.S. Department of Agriculture, Agricultural Research Administration.

Kearney, T.H., R.H. Peebles, J.T. Howell and E. McClintock. 1960. Arizona Flora. 2nd ed. Berkeley, CA; University of California Press.

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Evaluation of Accessions of Tobosagrass from Southeastern Arizona (MLRA 41)

STUDY NUMBER: AZPMC-P-0603-CR

STUDY NUMBER: AZPMC-T-0604-CR

Description

The tobosagrass (*Pleuraphis mutica* Buckl.) initial evaluation planting (IEP) consists of 17 accessions collected from Major Land Resource Area (MLRA) 41 the Southeastern Arizona Basin and Range in southeastern Arizona and southwestern New Mexico. This area is a transition between the Chihauahuan and the Sonoran Desert regions. The plant selection study is designed to evaluate the genetic diversity among populations of tobosagrass in this area. The technology development study will evaluate and develop production techniques and a protocol for commercial use of any potential release.

Objectives of these studies are:

1. Evaluate the diversity among accessions in this collection.

2. Evaluate phenotypic characters of accessions in this collection.

3. Develop production protocols.

4. Determine yield potential of seed and forage.

5. Produce a selected release for MLRA 41.

Duration of Study: 2006 through 2010

Study Leaders: Ramona Garner and Mary Hershdorfer

Location: Tucson Plant Materials Center, Tucson, Arizona

Introduction

Tobosagrass (also known as Tobosa) is a native, rhizomatous, warm season perennial sod-forming grass (Kearney et.al., 1960). Plants may grow to 3 feet (0.9 m), but normally are 1 to 2 feet tall (0.3-0.6 m). Seed stalks are smooth and erect and 1.2 to 3 feet (30-75 cm). The leaves are up to 6 inches (15 cm) long, stiff, harsh and hairless, occurring mainly as a mass of basal leaves with only a few located along the stem. The inflorescence consists of an erect spike 1.5 to 3 inches (4-8 cm) long, broad and white, straw colored or occasionally purplish. Spikelets are upright in clusters of three with about 30 fascicles on each spike. Each fascicle is shed as a unit. (Gould, 1979). Chromosome numbers reported for tobosa are 2n = 36, 54. (Flora of North America, 2003)

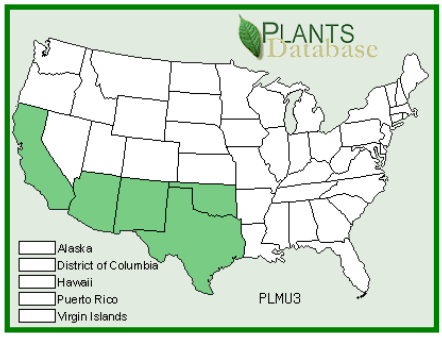


Fig. 1. Distribution of tobosagrass in North America

Tobosa is characteristically found in soils that have developed from basin fill material. These are clay soils that are tight and relatively impervious. Where surface runoff accumulates for a few days, almost pure stands forming a dense course sod may occur. Tobosa occurs on dry mesas,

sandy-loam hills and rocky slopes. On drier sites it grows in scattered stands of large, individual tufts. In Arizona tobosag grows from 2,460 to 5,906 feet (750-1800 m) (Gould, 1979).

Tobosa is important forage for livestock in the southwest. It is often maligned as forage because it is only palatable during the rainy season when it is green and succulent. During the growing season, Tobosa can produce protein of 8 to 10% and 1,000 to 1,500 lbs of forage per acre (Anderson, 1988 and Wright, 1969).

Materials and Methods

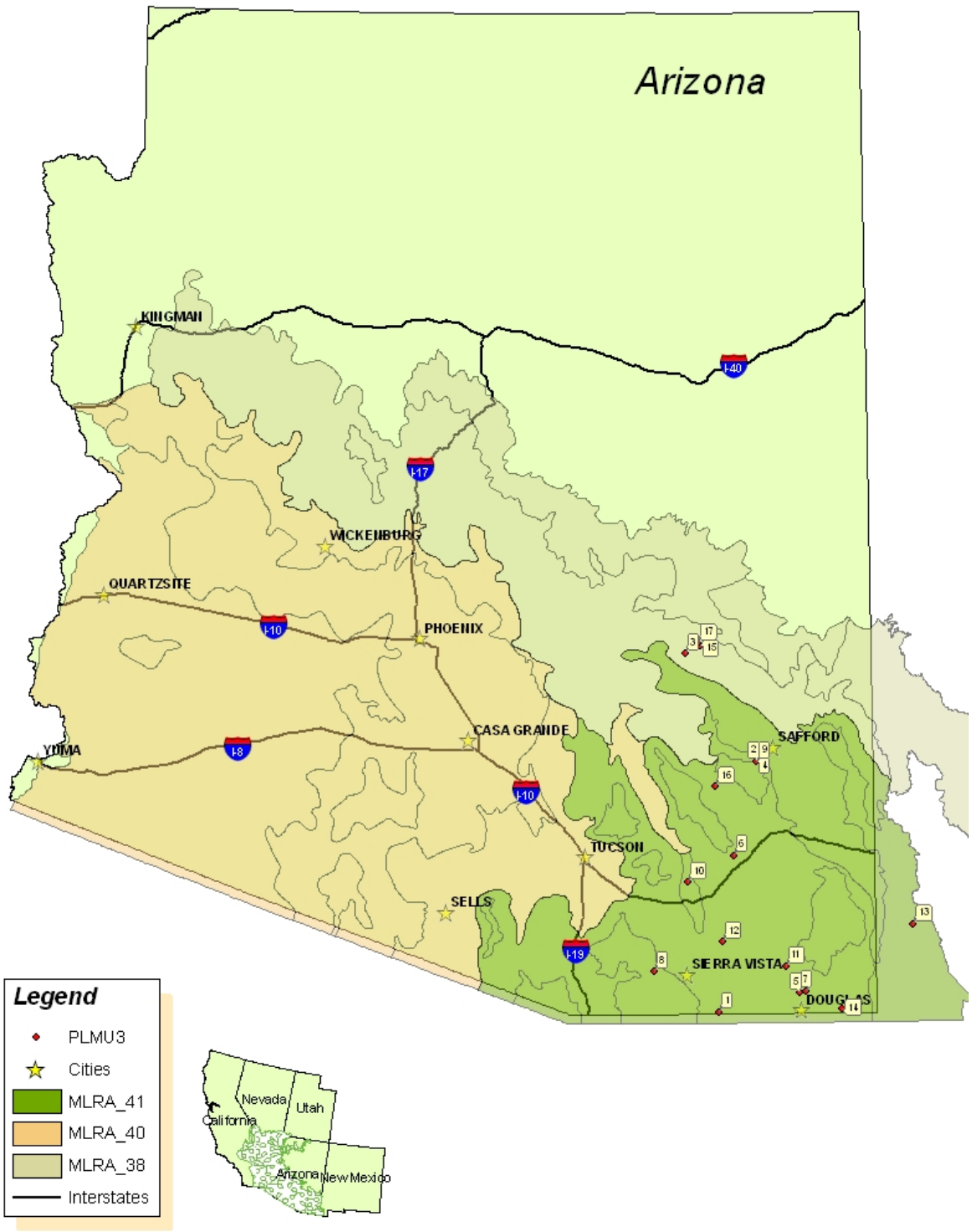
Eighteen accessions from MLRA 41 (Table 1) were grown in 35mm Jiffy forestry pellets in the greenhouse for 6 weeks. They were planted in July 2006into a randomized complete block design (RCB) with 8 replications. Each experimental unit consists of 5 individual plants. Plugs were planted into the field 18 inches apart with 40 inch centers. Extra accessions were planted at the end of the plot to fill out the field. A pre-plant application of 100 lbs/acre of ammonium phosphate (11-48-0 $[NH_4)_3PO_4]$) was applied and the planting is irrigated as needed.

Results

In future growing seasons the accessions will be evaluated for characters such as size, flowering date, germination and vigor. Agronomic techniques will be evaluated to determine yield potential of seed and forage.

Table 1. Accession number and collection location of 17 accessions in initial evaluation of tobosagrass.

Number	Accession Number	Collection Location	Number	Accession Number	Collection Location
1	9092489	-110.0934 31.3439	10	9092627	-110.2942 32.0792
2	9092490	-109.8287 32.7615	11	9092657	-109.6467 31.5997
3	9092491	-110.3000 33.3732	12	9092658	-110.0661 31.7411
4	9092492	-109.8287 32.7617	13	9092668	-108.8011 31.8253
5	9092522	-109.5525 31.4467	14	9092688	-109.2758 31.3556
6	9092562	-109.9865 32.2312	15	9092701	-110.1989 33.4158
7	9092575	-109.5148 31.4598	16	9092707	-110.1011 32.6214
8	9092576	-110.5189 31.5756	17	9092720	-110.2139 33.4317
9	9092577	-109.8289 32.7615			


Arizona
KINGMAN
I-40
I-17
WICKENBURG
QUARTZSITE
I-10
PHOENIX
CASA GRANDE
YUMA
I-8
I-10
SAFFORD
TUCSON
SELLS
I-19
SIERRA VISTA
DOUGLAS
Legend
PLMU3
Cities
MLRA_41
MLRA_40
MLRA_38
Interstates
Nevada
Utah
California
Arizona
New Mexico

Literature:

Anderson, D.M. 1988. Seasonal stocking of tobosa managed under continuous and rotation grazing. Journal of Range Management. 41(1):78-83.

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Gould, F.W. 1977. Grasses of Southwestern United States. University of Arizona Press, Tucson, AZ.

Hitchcock, A.S. 1951. Manual of the Grasses of the United States. Misc. Publ. No. 200 Washington, DC; U.S. Department of Agriculture, Agricultural Research Administration.

Kearney, T.H., R.H. Peebles, J.T. Howell and E. McClintock. 1960. Arizona Flora. 2nd ed. Berkeley, CA; University of California Press.

Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean and the Pacific Basin. 2006. USDA Handbook 296. USDA-Natural Resources Conservation Service. Washington, DC.

Wright, H.A. 1969. Effect of spring burning on tobosa grass. Journal of Range Management. 22 (6) : 425-427.

2006 Field Plantings in Southern Arizona

STUDY NUMBER: AZPMC-F-0602-CR
STUDY NUMBER: AZPMC-F-0703-CR
STUDY NUMBER: AZPMC-T-0610-CR
STUDY NUMBER: AZPMC-T-0613-CR

Four field plantings were conducted between July and August 2006 in Southern Arizona using the Truax II Seed Drill. The primary purpose of these field plantings was to assess the germination of Tucson PMC plant materials developed for southern Arizona in a variety of southern Arizona locations.

Field Planting on Vaca Ranch after fire.

The first planting took place on the Vaca Ranch in the San Raphael Valley of Santa Cruz County. The Tucson NRCS Field Office assisted with this planting. This site was selected because sections of the ranch, which is dominated by exotic Lehmann lovegrass, had burned that summer. We were curious to see if planting native species, using seed harvested from a local site, could tip the scale toward native species germination after fire. A variety of species were planted, including *Eragrostis intermedia, Bouteloua gracilis, B. hirsuta, B. eriopoda, B. curtipendula, B. chondrosioides, Bothriochloa barbinodis, Digitaria californica, Lycurus phleoides, Leptochloa dubia, Aristida spp., Sida filicaulis, Ipomoea coccinea, Viguiera annua, convolvulus equitans*.The seed mix was from a native harvest from a nearby ranch.

Field Planting on the Flying W Ranch

The second planting took place on Flying W Ranch near Winkleman, AZ in Pima County. Again, the Tucson Field Office assisted with this planting. The site chosen for planting has been used for years for NRCS plantings. Vegetation was removed prior to planting and the 3 to 5 acre plot is fenced to protect it from grazing. Four TPMC releases were tested in plots at this site at two rates, the standard rangeland rate of approximately 20 seed/ac (the rate the drill was set) and a doubled rate, where the drill was passed through the plot twice. 'Loetta' Arizona Cottontop (*Digitaria californica*), Pima germplasm Pima pappusgrass (*Pappophorum vaginatum*), 'Stevan' Plains bristlegrass (*Setaria leucopila*) and Cochise germplasm Spike dropseed (*Sporobolus contractus*). The 8

plots were marked with GPS and observed that fall. A visual observations immediately following the summer rains determined that Arizona cottontop at the double rate had good germination.

The third planting took place on a ranch near Bonita, AZ in Cochise County. The Wilcox Field Office assisted with this planting. The planting site was a wide open and unvegetated site located within view of a well-traveled road, and not to be grazed for an extended period of time. Sufficient space allowed for 550 ft by 24 ft plots. Five TPMC releases were tested. The same four releases listed above were planted at both rates, as well as approximately 5 lb of 'Salado' Cane beardgrass. This increased rate was used for Cane beardgrass because the seed was too fluffy to pass through the drill at the standard rangeland rate. Approximately 3 ac were planted in total, about 0.3 ac/treatment for the 10 treatments.

Field planting near Bonita

A fourth planting took place on a ranch near Hot Well Dunes near Safford, a site on reclaimed farmland beside the Gila River. The Safford Field Office assisted with this planting. The previous year swales had been worked into the site to retain water, however no vegetation had established on the site. Ten plots of the same treatments as the Bonita planting were placed between the swales and plot locations were recorded with GPS. Approximately 3 ac total were planted, between 0.2 and 0.4 ac of each of the 10 treatments. Follow-up visual observations determined that no germination took place in any of the plots. The rapid movement of water between the swales or soil salinity may be preventing seedling establishment.

Field Planting on the near Safford